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Errata

Page 143, line 26, the combination *Fallugia acuminata* had been published previously (Cockerell, Proc. Acad. Nat. Sci. Phila. 1903 : 590).

Page 144, lines 26 and 27, *for* Rydb. & Smith *read* Smith & Rydb.

Page 146, line 5, the combination *Cactus similis* had been published previously (Small, Fl. S.-E. States 812. 1903).

Page 146, line 21, the combination *Anogra latifolia* had been published previously (Rydb. Bull. Torrey Club 31 : 570. 1904).

Page 149, line 25, for *Watsonii* read *Watsoni*.

Page 151, line 29, the combination *Myzorrhiza ludoviciana* had been published previously (Small, Fl. S.-E. States 1093. 1903).

Page 152, line 4, the combination *Distegia involucrata* had been published previously (Cockerell, Univ. Colo. Stud. 3 : 50. 1905).

Page 153, line 20, for *ericaefolius* read *ericoides*.

Page 155, line 2, for *Schkuria* read *Schkuhria*.

Page 155, line 19, *Tetraneuris stenophylla* had been published previously (Rydb. in Britton, Man. 1009. 1901).

Page 457, line 19, for *Elliottiana* read *Elliottii*.

Page 473, line 7, the combination *Asplenium biscaynianum* is not new.

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BULLETIN

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Hepaticae of Puerto Rico

VI. CHEILOLEJEUNEA, RECTOLEJEUNEA, CYSTOLEJEUNEA, AND PYCNOLEJEUNEA

ALEXANDER WILLIAM EVANS

(WITH PLATES 1–3)

CHEILOLEJEUNEA

The genus *Cheilolejeunea* is not very clearly defined by writers, and some of the species which have been referred to it present but few characters in common. In Spruce's original description of the group as a subgenus, the following are the most important peculiarities to which he calls attention: the prostrate stems and branches; the more or less closely imbricated leaves; the oblong-falcate lobes, semicordate at the base, usually rounded at the apex, and entire or minutely crenulate on the margins; the inflated lobules, one fourth to one third as long as the lobes; the small and often convex leaf-cells, with trigones; the suborbicular underleaves, one fourth to one half the size of the lobes, bifid to the middle or less with acute segments; the variability in the length of the female branch; the usual but not constant absence of a subfloral innovation; the falcate and spreading bracts, the lobe being commonly broad and rounded and the lobule narrower and acute; the oval bracteole, shortly bifid at the apex or undivided; the more or less compressed perianth with theoretically four or five keels, the antical keel being low and often obsolete, the two lateral keels sharp, the two postical keels low and blunt and often confluent into a single broad and rounded keel.* The name of the group refers to the fact that the perianth often becomes two-

* Hep. Amaz. et And. 251. 1884.

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lipped upon the extrusion of the capsule at maturity, a condition brought about by rupture and therefore of but slight taxonomic importance. It will be seen that certain of the characters just noted are vague and elastic, and this is especially true of those ascribed to the lobules and to the floral organs. In fact, the description as it stands would apply to certain recognized species of *Euosmolejeunea*, *Pycnolejeunea*, or *Lejeunea* proper. Two later descriptions of the genus have been published, one by Schiffner * and the other by the writer, † but these are both abridged from the original description and add no new characters of importance.

The type species of *Cheilolejeunea* is somewhat difficult to determine. The first species which Spruce mentions is *L. confluens* Lindenb.; ‡ the first species which he describes is his new *L.* (*Cheilo-Lejeunea*) *aneogyna;* the first species which Schiffner lists in raising the group to generic rank is *Cheilolejeunea heteroclada* (Spruce) Schiffn. Apparently any one of these three species has some claims to be considered the generic type. It seems most logical, however, to assign this honor to the first species which Spruce describes, namely to **Cheilolejeunea aneogyna** (Spruce) comb. nov., in spite of the fact that this particular species does not happen to be mentioned by Schiffner.

Among the many species which have been referred to *Cheilolejeunea* by various writers, at least three distinct types of lobule are represented. In the first type, which is clearly exhibited by *C. aneogyna*, the lobule is strongly inflated but is more or less abruptly contracted in the outer part, where a circular opening into the water-sac is to be seen (plate 1, figure 1). The keel is arched, and the free margin is involute to beyond the apex and then passes by a shallow sinus to the end of the keel. The apex is tipped with a single cell, at the distal base of which is a hyaline papilla in a slight depression. In *C. aneogyna* and its immediate allies the apical tooth is long and sharp (figure 4); it lies appressed to the lobe and extends nearly or quite to the end of the keel, playing an important part in the formation of the opening into the water-sac. In other species, however, the tooth is short and

* Engler & Prantl, Nat. Pflanzenfam. 1^3: 124. 1893.

† Trans. Conn. Acad. 10: 435. 1900.

‡ G. L. & N. Syn. Hep. 365. 1845.

blunt. The lobule just described is built up on essentially the same plan as in the genera *Cyrtolejeunea* and *Euosmolejeunea.*

The second type of lobule (figure 11) is well seen in *C. versifolia* (Gottsche) Schiffn. and in *C. phyllobola* (Nees & Mont.) Schiffn.; it corresponds more nearly with that found in *Prionolejeunea* and in several other genera of the *Lejeuneae Schizostipae.* The most important difference between this type of lobule and that described for *C. aneogyna* is in the position of the hyaline papilla, which is here at the proximal base of the apical tooth. The tooth itself is subject to considerable variation, being long and sharp in *C. versifolia* and short and blunt in *C. phyllobola;* in some species it is distinctly curved, in others straight or nearly so. The papilla is usually in a distinct depression, which in some cases at least is formed by the curved base of the apical tooth (figure 15).

The third type of lobule is apparently confined to *C. lineata* (Lehm. & Lindenb.) Schiffn. (plate 3, figures 1–3). It bears a strong resemblance to the spherical lobules found in certain species of *Ceratolejeunea* and is possibly to be considered an extreme modification of the second type. It is even more strongly inflated than in the two other types described and is very abruptly contracted in the outer part, the opening into the water-sac being extremely small. The keel is so strongly arched as to be approximately semicircular in outline. The free margin is rounded and throughout its entire length is involute and appressed to the lobe; the fold of involution is also strongly arched, very much as in the keel, so that the entire lobule appears broadly ovoid or ellipsoidal in form. If the free margin is examined in the outer part, close to the end of the keel, a slight indentation may be detected from which a hyaline papilla arises (figure 8). A study of very young leaves shows that the rounded cell just beyond the papilla represents the apical tooth, although it is scarcely to be distinguished from its neighbors. The papilla, therefore, is proximal in position. The sinus is represented by the very few cells between the apical tooth and the end of the keel and is consequently unusually short. The hyaline papilla in *C. lineata* was noticed many years ago by Leitgeb.* It is, however, difficult to demonstrate

* Unters. über Lebermoose 2: 14. 1875.

because, instead of projecting beyond the free margin of the lobule, it bends sharply backward from its base and lies closely appressed to the inner surface. This position is assumed in very immature leaves and is maintained as long as the papilla persists.

The lobular differences just described are accompanied by other differences of greater or less importance. In the opinion of the writer they form a convenient basis for the segregation of the old genus *Cheilolejeunea* into three genera. The first of these, for which the name *Cheilolejeunea* may be retained, is made up of species showing the first type of lobule. For species showing the second type, the name *Rectolejeunea* is suggested. *C. lineata*, finally, which exhibits the third type of lobule, seems sufficiently distinct to represent the new genus *Cystolejeunea*. Unfortunately the structure of the lobule has not been carefully described for all of the species which have been referred to *Cheilolejeunea*, and certain of these cannot be definitely assigned at the present time. It is even probable that some of them will fit more naturally into *Euosmolejeunea* or *Pycnolejeunea* than into any one of the proposed generic segregates.

In its restricted sense the genus *Cheilolejeunea* is best developed in the tropical and subtropical regions of America. So far as we know at present the species are all found on bark, where they sometimes form pure mats and sometimes grow mixed with other hepatics of similar habit. The only species known from Puerto Rico is *C. decidua* (Spruce) Evans.

The plants belonging to this genus are pale- or bright-green in color and are never glossy; upon drying they sometimes become brownish. The stems are prostrate and loosely adherent to the substratum, the rhizoids being sparingly developed. The lobes of the leaves are plane or slightly convex and are also appressed to the substratum (plate 1, figure 1); they are falcate and vary in shape from ovate to orbicular; the apex is broad and usually rounded, and the margin, which is entire or nearly so, is also rounded but never distinctly cordate at the antical base. The leaf-cells are plane or slightly convex, with firm walls; trigones are distinct and often conspicuous, and intermediate thickenings occasionally occur (figure 2). Ocelli are not developed. The underleaves are distant and small, being scarcely twice the width

of the stem; they are suborbicular in outline, bifid to the middle or less, with acute divisions, and their margins are entire or nearly so.

The female inflorescence is sometimes borne on a leading branch and sometimes on a short branch, and in the latter case the number of branch-leaves may be reduced to one or two pairs. Variations in the length of the branch are often to be observed in a single individual. In certain species the branches bearing perianths are invariably simple; in other species subfloral innovations are constantly produced. The bracts are larger than the leaves which immediately precede them, but are sometimes exceeded in size by the leaves on robust and sterile shoots; they are unequally bifid and usually distinctly complicate, the lobe being broad and rounded, and the lobule narrower and commonly acute. The bracteole is similar to the underleaves, but is larger and less deeply bifid. The perianth is distinctly compressed, the lateral keels being sharp; the antical face is plane or nearly so, and the postical keel is either rounded or two-angled; the apex is broad, varying from rounded to slightly retuse, and the beak is distinct but sometimes very short. The antheridial spike sometimes occupies a short branch and is sometimes terminal on a longer branch; the antheridia usually occur in pairs, but the bracts themselves offer no generic characters of importance.

As thus emended, *Cheilolejeunea* is apparently more closely related to *Euosmolejeunea* than to any other genus. Typical species of the two genera are, to be sure, amply distinct. Such a *Euosmolejeunea*, for example, as *E. trifaria* (Nees) Schiffn. is characterized by its yellowish-green color, by its large and cordate underleaves, by the constant presence of a subfloral innovation, and by its sharply keeled perianth. Unfortunately there are other species of the genus in which all of these differential characters are not clearly exhibited. The underleaves, for example, may be small and cuneate at the base, and the antical keel of the perianth may be low or even obsolete. It is sometimes necessary, therefore, as in other similar cases, to rely on a combination of characters rather than on a single generic difference.

CHEILOLEJEUNEA DECIDUA (Spruce) Evans

Lejeunea (*Cheilo-Lejeunea*) *decidua* Spruce, Hep. Amaz. et And. 257. 1884.

Cheilolejeunea decidua Evans, Bull. Torrey Club **32**: 188. 1905.

Pale- or brownish-green, growing in depressed mats: stems 0.12 mm. in diameter, copiously and irregularly branched, the branches obliquely to widely spreading, prostrate or ascending, sometimes like the stem but often with smaller and deciduous leaves; rhizoids present on the prostrate axes, few or wanting on the ascending branches: leaves (when well developed) imbricated, the lobe plane or slightly convex, obliquely spreading, ovate, 0.7 mm. long, 0.4 mm. wide, attached by an almost longitudinal line of insertion, antical margin arching across or just beyond the axis, strongly curved to apex, postical margin straight or nearly so, apex broad and rounded, margin entire; lobule triangular-ovate in outline, 0.17 mm. long, 0.12 mm. wide, keel slightly arched or almost straight, free margin straight or nearly so, apical tooth long, pointed and slightly curved, appressed to the lobe and forming part of the opening into the water-sac; cells of lobe plane, averaging 12 μ at the margin, 21 μ in the middle and 30 × 23 μ at the base, sometimes thin-walled throughout, but usually with small triradiate trigones and occasional intermediate thickenings: underleaves distant, plane, orbicular, 0.2 mm. long, often cuneate toward the base, bifid one third to one half, with broad, triangular, erect, acute, subacute or apiculate divisions separated by a broad and obtuse sinus; margin entire or sinuate: inflorescence dioicous: ♀ inflorescence borne on a short and usually simple branch, rarely with an innovation on one side; bracts obliquely spreading, more or less complicate, the lobe oblong to obovate, 0.65 mm. long, 0.4 mm. wide, subfalcate, rounded at the apex, entire, lobule linear, 0.3 mm. long, 0.1 mm. wide, acute to rounded at the apex; bracteole free, obovate, 0.5 mm. long, 0.35 mm. wide, bifid about one sixth with obtuse to acute lobes and sinus, margin entire; perianth broadly obovate in outline, 0.6–0.75 mm. long, 0.5 mm. wide, strongly compressed, antical face plane or slightly concave, lateral keels sharp, postical keel low and broad, rounded or bluntly two-angled, apex rounded to slightly retuse, with a short but distinct beak: ♂ inflorescence occupying a short branch or terminal on a longer branch; bracts in one to three pairs, subimbricated, strongly inflated, shortly and subequally bifid with rounded divisions, keel strongly arched; antheridia borne singly or in pairs: mature sporophyte not seen: vegetative reproduction by means of leafy propagula growing from the leaf-cells (PLATE 1, FIGURES 1–9).

On a log. El Yunque, *Evans* (*161*). The species was originally collected by *Spruce* in the region of the Amazon and has recently been collected in southern Florida.

The deciduous leaves of this interesting species are set free by a tearing across of the lobe near the lobule, sometimes leaving a complete water-sac behind, sometimes tearing away a portion of its wall; in any case the lobule is left intact (figure 7). The lobes which thus separate play an important part in the vegetative reproduction of the species. Even before they become detached they are able to produce straight and unbranched rhizoids, which grow out from scattered marginal or submarginal cells. By means of these rhizoids the lobes attach themselves to the substratum and give rise directly to leafy shoots, without the interpolation of any protonemal structures whatever. Each shoot has its origin in a single leaf-cell, and there are usually from one to three shoots developed on each lobe (figure 8). The first leaves on these shoots are very small, both lobe and lobule being extremely rudimentary. As growth proceeds the leaves gradually acquire a more normal appearance, the first parts to develop being the lobule and enough of the lobe to form the water-sac. The underleaves as a rule appear very early, but in some cases their development is postponed, and several pairs of rudimentary leaves will be found without any corresponding underleaves (figure 9). These variations in development are probably caused by differences in light and moisture.

Apparently the closest ally of *C. decidua* is *C. jamaicensis* Steph.,* a species which has not yet been reported except from Jamaica. *C. jamaicensis* is a more robust plant, larger in all its parts and with much more conspicuous thickenings in its cell-walls. The male inflorescence sometimes forms a long spike with from six to ten pairs of bracts, although it is sometimes much shorter. The leaves in this species show no evidence of being deciduous. *C. aneogyna* also retains its leaves. It differs from *C. decidua* in its smaller size and greater delicacy, in its more falcate lobes, the postical margin being distinctly rounded, and in its autoicous inflorescence.

* Hedwigia 34: 241. 1895.

RECTOLEJEUNEA

The genus *Rectolejeunea* attains its highest development in the tropical and subtropical regions of America. In fact it is doubtful if it is represented elsewhere. In Puerto Rico four species have been collected, none of them in abundance. All of these four species occur on other West Indian islands, and two of them have been found in southern Florida. All of the known species grow on bark. The genus may be characterized as follows: —

RECTOLEJEUNEA gen. nov.

Lejeunea p. p. G. L. & N. Syn. Hep. 1845.

Lejeunea subgenus *Cheilo-Lejeunea p. p.* Spruce, Hep. Amaz. et And. 1884.

Cheilolejeunea p. p. Schiffn.; Engler & Prantl, Nat. Pflanzenfam. 1^3: 124. 1893.

Plants small to medium-sized, sometimes delicate in texture, sometimes firmer, pale- to deep-green, often becoming brownish with age, not glossy: stems prostrate and adherent to the substratum, more or less branched, the branches prostrate or ascending: leaves loosely imbricated, the lobe widely spreading, somewhat falcate, ovate to orbicular in outline, plane or nearly so, rounded at the apex or very obtuse, margin entire or sparingly and minutely crenulate; lobule inflated and forming a distinct water-sac, keel straight or slightly arched, free margin involute throughout a part of its length, tipped at the apex by a single cell bearing a marginal hyaline papilla at its proximal base; leaf-cells plane or slightly convex, the walls sometimes thin with more or less evident trigones, sometimes more uniformly thickened; ocelli frequently present: underleaves small, distant to subimbricated, orbicular to ovate, bifid to the middle or beyond with variable divisions and sinus: inflorescence autoicous or dioicous: ♀ inflorescence sometimes borne on a short branch, sometimes on a leading branch, simple or innovating on one side; bracts obliquely spreading, complicate, unequally bifid; bracteole similar to the underleaves but larger and usually less deeply bifid; perianth usually obovate in outline, compressed, the lateral keels prominent and commonly sharp, antical face plane or nearly so, postical keel low and broad, rounded or two-angled, apex truncate or slightly retuse, with a short but distinct beak: ♂ inflorescence occupying short branches or intercalary on longer branches; bracts imbricated, diandrous (so far as known): vegetative reproduction by means of deciduous leaves. (Name from *ῥηκτός*, fragile, and

Lejeunea, in allusion to the fact that the leaves in most of the species easily become broken off.)

In distinguishing *Rectolejeunea* from the genera to which it is closely allied, the most trustworthy characters are those derived from the lobule and from the perianth. The latter organ is essentially the same as in *Cheilolejeunea*, but the lobule, as has already been pointed out, is built up on an entirely different plan. In the structure of the lobule, however, *Rectolejeunea* agrees pretty closely with *Pycnolejeunea* and *Lejeunea*, and it is here that the flattened perianth with its plane antical face serves as a distinguishing mark. So far as the structure of the leaves and underleaves is concerned, the new genus is in many respects intermediate between *Pycnolejeunea* and *Lejeunea*. It would even be possible, if the perianths were left out of consideration, to divide the species of *Rectolejeunea* between these two genera, without violating to any great extent their natural relationships.

Of the four species noted below two have recently been described by the writer in another connection. It has therefore seemed unnecessary to redescribe them in full. The first species may be considered the type of the genus.

Rectolejeunea flagelliformis sp. nov.

Pale-green, becoming brownish with age, scattered or growing in depressed mats: stems 0.09 mm. in diameter, closely adherens to the substratum, sparingly and irregularly pinnate, the branchet widely spreading, not microphyllous; rhizoids numerous: leaves imbricated, the lobe plane and appressed to the substratum, slightly falcate, ovate, 0.7 mm. long, 0.4 mm. wide, antical margin rounded at the base, arching partially or wholly across the axis and outwardly curved to the apex, postical margin straight or nearly so, apex broad and rounded, margin entire or minutely and irregularly crenulate from projecting cells; lobule inflated, ovate in outline, 0.17 mm. long, 0.12 mm. wide, keel slightly arched, forming an almost continuous line with the postical margin of lobe but usually with a notch at the junction, free margin curved, involute at the base but appressed to the lobe throughout the greater part of its length, apical tooth long and sharply curved, papilla in a distinct depression, sinus lunulate; cells of lobe plane or slightly convex, averaging 9 μ at the margin, 14 μ in the middle and 18 × 16 μ at the base, rather thick-walled but without distinct trigones; ocelli mostly three to six, arranged in one or two short

rows at the base of the lobe, 25 μ long, 21 μ wide: underleaves distant, orbicular, 0.2 mm. long, broadly cuneate at the base and bearing a distinct radicelliferous disc, bifid about one half with erect lobes, rounded to acute at the apex, and a narrow and usually acute sinus, margin entire or rarely angular-dentate on the sides: inflorescence autoicous: ♀ inflorescence usually borne on a short branch (with only one or two pairs of leaves), innovating on one side, the innovation simple or again floriferous; bracts obliquely spreading, complicate, the lobe plane or nearly so, oblong-ovate, 0.75 mm. long, 0.35 mm. wide, slightly falcate, mostly rounded at the apex, margin entire, keel narrowly winged, lobule ovate, 0.35 mm. long, 0.17 mm. wide, obtuse to acute at the apex, margin entire; bracteole convex when seen from below, slightly connate with both bracts, orbicular, 0.55 mm. long, apex broad, varying from rounded and undivided to sharply and acutely bidentate, margin usually entire, sometimes irregularly dentate in the upper part; perianth about half exserted, obovate in outline, 0.75 mm. long, 0.45 mm. wide, somewhat compressed, the lateral keels sharp, antical surface plane or with a very indistinct keel in the upper part, postical keel broad and two-angled, apex broad, truncate or slightly retuse, beak short, surface smooth or slightly roughened from projecting cells, especially along the keels: ♂ inflorescence occupying a short branch or terminal on a longer branch, sometimes proliferating from the apex; bracts in from two to ten pairs, imbricated, strongly inflated, shortly bifid with an arched keel, the lobe rounded at the apex, the lobule more or less pointed; bracteoles one or two at the base of the spike, similar to the underleaves; antheridia in pairs: mature sporophyte not seen (PLATE 1, FIGURES 10–25).

On bark of trees. El Yunque, *Evans* (*29*). The species has also been found in Cuba, at the base of the El Yunque Mountain, Baracoa, by *Underwood & Earle*, and *no. 346* of these collectors may be designated the type. No other localities for the plant are definitely known at the present time.

The writer's account of *R. flagelliformis* is drawn from what may be considered the normal condition of the species. Under some circumstances, however, the appearance of the plants is completely altered, owing to the development of peculiar organs of vegetative reproduction. These consist of modified leaves, which are borne on the ascending or upright prolongations of prostrate branches. Sometimes a flagelliform branch of this nature represents the continuation of an ordinary leafy axis (figure 23), some-

times the proliferation of an antheridial spike, sometimes the innovation of a female inflorescence. In any case the growth of the branch is sooner or later brought to an end, although in one observed instance as many as fifty modified leaves had been developed. The formation of these peculiar branches is apparently induced by crowding, and it is not unusual to find them in the middle region of a tuft, the marginal part of which continues to develop branches of the normal type.

The modified leaves are strikingly different from ordinary leaves in their appearance. They are densely imbricated, and the line of insertion is nearly transverse and very short, measuring but five to ten cells in length. No lobules are developed, and the lobes are ovate in shape and almost symmetrical. The margin is not entire, as on normal leaves, but bears a series of scattered hair-like teeth, which vary in number from one to ten. The teeth are irregular in arrangement, but the one at the apex is usually distinct, thus making the leaves acuminate. Each tooth is composed of a single row of cells or is rarely two cells wide at the very base; it is sometimes straight and sometimes variously curved or hooked at the tip. In the majority of cases the terminal cell is long and delicate, like a rhizoid, and occasionally the entire tooth is reduced to a cell of this character. The leaf-cells have much thinner walls than ordinary leaves and are well supplied with chloroplasts.

The leaves just described develop rapidly and become detached as soon as they attain their full size. The line of rupture is very close to the base, and the detached leaf leaves behind a narrow ridge of projecting cells, the process of separation being schizolytic in nature. A separated leaf is able to live a considerable time on account of its many chloroplasts, but it soon gives rise to one or more leafy shoots, without the interpolation of thalloid structures. Apparently any marginal cell has the power of developing into a shoot of this nature (figure 24), but the number growing from a single leaf is always very small.

The underleaves on the flagelliform branches are not deciduous; they are closely imbricated like the leaves, and are more or less squarrose, thus giving the branches a peculiar and characteristic appearance. The underleaves do, however, exhibit marked modi-

fications. In the first place, they lose largely, if not entirely, the power of developing rhizoids. In the second place, the lateral teeth, which are sometimes vaguely indicated on normal underleaves, become very distinct, often attaining a length of three cells and a width of two cells at the base. In the third place the principal divisions become sharply pointed, usually ending in a row of from two to four cells, and the sinus becomes broad and lunulate (figure 25).

The leaves which precede the modified leaves exhibit transitional characters. They tend to become more pointed, scattered marginal cells grow out into rhizoidal processes or even into short teeth, and the lobule becomes smaller and more rudimentary. It is interesting to note that a branch which bears these transitional leaves sometimes recovers from the tendency to become flagelliform and continues its growth normally. In one case, for example, the proliferation of an antheridial spike developed first a normal leaf, then a series of transitional leaves, then a second antheridial spike. It is also probable that the dentate or ciliate bracts and bracteoles, which are occasionally to be observed on a female inflorescence, represent similar transitional conditions. In these cases the development of the archegonium, of course, terminates the elongation of the branch; but in one observed instance the innovation from a flower of this character became flagelliform almost immediately, showing that the tendency toward such development was present in a marked degree.

Rectolejeunea Berteroana (Gottsche)

Lejeunea (*Odontolejeunea*) *Berteroana* Gottsche in Stephani, Hedwigia **27**: 282. *pl. 11, f. 6.* 1888.

Lejeunea versifolia Gottsche in Wright, Hep. Cubenses (without description); Schiffner, Bot. Jahrb. **23**: 597. 1897 (as synonym).

Cheilolejeuna versifolia Schiffn. *l. c. pl. 5, f. 1–7.*

On bark of trees. Puerto Rico, *Bertero*, the type locality. The species is also known from Cuba (*Wright*), from southern Florida (*Underwood*), and from the Bahamas (*Mrs. Britton*).

R. Berteroana and the preceding species are very closely related. They agree in the shape of their leaves and underleaves,

in the peculiarities of the lobule with its long apical tooth and proximal papilla, in the structure and measurements of the leaf-cells, in the presence of basal ocelli and in the possession of subfloral innovations. Both species, moreover, develop flagelliform branches with deciduous leaves. An excellent account of these branches in *C. versifolia* is given by Schiffner, who assumes that they are leafless from the beginning. The Florida specimens, however, recently recorded by the writer, * clearly show that the development of these branches is the same here as in *R. flagelliformis* and that the narrow and ring-like thickenings, which Schiffner notes, are simply the bases of the leaves which have fallen away. These deciduous leaves in *R. Berteroana* are also destitute of lobules and almost symmetrical, but their margins differ from those of *R. flagelliformis* in being either entire or only sparingly and indistinctly dentate instead of ciliate. The margins of the corresponding underleaves are also either entire or very bluntly unidentate on the sides. Aside from these differences in the flagelliform branches, which are among the most important in distinguishing the two species, *R. Berteroana* differs in its smaller size and dioicous inflorescence.

Stephani's figure of *Lejeunea Berteroana* shows a portion of a sterile stem and brings out clearly the normal peculiarities of the leaves and underleaves. Although there is no indication either here or in the original description of flagelliform branches, the type material in the Gottsche herbarium exhibits a branch of this character and proves conclusively that *L. Berteroana* and *Cheilolejeunea versifolia* are to be considered synonyms. The perianth of the species is still unknown, but its close relationship to *R. flagelliformis* seems to warrant placing it in the same genus. At any rate the structure of the lobule and the entire leaves would exclude it from *Odontolejeunea*, and the latter character would also remove it from *Cyclolejeunea*.

* Mem. Torrey Club **8**: 145. 1902. A full description of the species, largely compiled from Schiffner, may also be found here.

Rectolejeunea emarginuliflora (Gottsche)

Lejeunea emarginuliflora Gottsche in Wright, Hep. Cubenses (without description); Schiffner, Bot. Jahrb. **23**: 585. 1897 (as synonym).

Cheilolejeunea emarginuliflora Schiffn. *l. c.*

Pale-green: stems scattered, 0.05 mm. in diameter, loosely adherent to the substratum, sparingly and irregularly pinnate, the branches widely spreading, not microphyllous but often with deciduous leaves; rhizoids few: leaves loosely imbricated, the lobe plane, slightly falcate, ovate, 0.5 mm. long, 0.35 mm. wide, antical margin rounded at the base, arching partially across the axis and outwardly curved to the apex, postical margin straight or nearly so, apex broad, rounded to very obtuse, margin entire or slightly and irregularly crenulate from projecting cells; lobule inflated, ovate in outline, 0.17 mm. long, 0.1 mm. wide, keel slightly arched, free margin curved, involute near the base, apical tooth curved but variable in length and sometimes short and blunt, papilla in a slight depression, sinus lunulate; cells of lobe plane, averaging 10 μ at the margin, 12 μ in the middle and 16 μ at the base, rather thick-walled but without distinct trigones; ocelli 23 × 16 μ, one or two at the base of the lobe, usually indistinct or obsolete: underleaves distant, plane, orbicular, 0.2 mm. long, broadly cuneate at the base and without a distinct radicelliferous disc, bifid about one half with erect divisions, rounded or obtuse at the apex and separated by a narrow and usually acute sinus, margin either entire or vaguely angular-dentate on the sides: inflorescence dioicous: ♀ inflorescence on a more or less elongated branch, innovating on one side, the innovation often floriferous; bracts and bracteoles similar to those of *R. flagelliformis*: perianth, ♂ inflorescence and sporophyte unknown (PLATE 2, FIGURES 1–8).

On bark of trees. North slope of the Luquillo Mountains, *Heller* (*4741 p. p.*). The original specimens were collected by *Wright* in Cuba, and no other stations for the species are at present known.

R. emarginuliflora is based on somewhat negative characters and is still too imperfectly known to be considered a well-established species. It agrees with *R. Berteroana* in its dioicous inflorescence and in the general characters derived from leaves and underleaves. Even the leaf-cells are of about the same size in the two species and agree with each other in the characters derived from their

cell-walls. The ocelli, however, which form a characteristic feature of *R. Berteroana*, are either indistinct in the present species or else are wholly undeveloped. *R. emarginuliflora* also fails to develop flagelliform branches, but these are replaced to a certain extent by ordinary leafy branches with scattered leaves. These leaves, which are scarcely or not at all modified, secure vegetative reproduction for the species in the same way that the crowded elobulate leaves do in *R. flagelliformis* and *R. Berteroana*. They easily become separated from the axis, usually carrying their lobules with them, and attach themselves to the substratum by means of scattered marginal rhizoids. When this is accomplished each leaf gives rise to one or more leafy shoots, sometimes with the interpolation of a thalloid protonema, sometimes directly from the leaf-cells (figures 7, 8). In the majority of cases the new shoots or their protonemata arise from marginal cells. It often happens that a branch loses many or all of its leaves in this way for a considerable distance and thereby acquires a peculiar appearance (figure 3), very different, however, from what is found in the flagelliform branches of the allied species. It approaches in this respect the following:—

Rectolejeunea phyllobola (Nees & Mont.)*

Lejeunea phyllobola Nees & Mont. in Ramon de la Sagra, Hist. Fis. Pol. y Natur. Cuba **9**: 281. 1845.

On bark of trees. Puerto Rico, without definite locality, *Underwood & Griggs* (*893*). Widely distributed in the West Indies; also known from Mexico, Costa Rica and southern Florida.

R. phyllobola bears a strong resemblance to the three preceding species. It differs from all of them, however, in its much larger leaf-cells, which average 21 μ in diameter in the middle of the lobe, in its complete lack of basal ocelli, and in the narrower divisions of its underleaves. The free margin of its lobule is involute to or just beyond the apex, and the apical tooth is distinguished by being short, blunt, and straight. The present species also develops branches with deciduous leaves, but these are scattered as on ordinary branches and no more modified than in *R. emarginuliflora*. Unfortunately the lobules in *R. phyllobola* are often poorly de-

* For a full description of this species, with synonymy and figures, see EVANS, Mem. Torrey Club **8**: 143. *pl. 20, f. 1–13*. 1902.

veloped, but even under these circumstances the relatively large leaf-cells will usually serve to distinguish the species.

CYSTOLEJEUNEA

The systematic position of *Lejeunea lineata* has long been a matter of uncertainty. Spruce first referred it to the subgenus *Macro-Lejeunea*, basing his opinion on the simple female branch and the perianth without keels. He afterwards followed Stephani and transferred it to *Cheilolejeunea*, apparently on account of the flattened perianth, but remarked at the same time that the species had certain characters in common with *Trachylejeunea*.* Schiffner also followed Stephani at first and considered the plant a *Cheilolejeunea;* afterwards he apparently reverted to the original view of Spruce and listed the species as *Macrolejeunea lineata*. This solution of the problem, however, by no means satisfied him, and he noted that the vegetative structure agreed in many respects with what is found in *Euosmolejeunea*. Still later he replaced the species in *Cheilolejeunea*.†

It will be seen from the above that *Lejeunea lineata* has certain points of agreement with four recognized genera of the *Lejeuneae*, but that the balance of opinion is in favor of placing it in *Cheilolejeunea*. Its peculiar lobule, however, should apparently exclude it not only from this genus, as emended in the present paper, but also from the other three genera to which it has been compared. It becomes necessary, therefore, to propose a new genus for its accommodation.

CYSTOLEJEUNEA gen. nov.

Plants rather robust, firm in texture, not glossy: stems prostrate, loosely adherent to the substratum, sparingly and irregularly branched, the branches widely spreading, not microphyllous: leaves imbricated, the lobe widely spreading, convex and reflexed at the broad apex, entire or nearly so; lobule strongly inflated, ellipsoidal or broadly ovoid, with strongly arched keel, free margin strongly involute throughout, apical tooth scarcely evident, hyaline papilla proximal, reflexed, sinus exceedingly short; leaf-cells convex with large trigones; ocelli none: underleaves distant, subrotund, cuneate at the base, bifid with sharp divisions: ♀ inflorescence borne on a

* Bull. Soc. Bot. de France **36**: clxxxii. 1889.—See also Jour. Linn. Soc. Bot. **30**: 331. 1894.

† Conspect. Hepat. Archip. Indici 256. 1898.

simple and very short branch; bracts obliquely spreading, shortly and unequally bifid, the lobe convex and broad at the apex, lobule variable; bracteole longer than the underleaves but less deeply bifid; perianth compressed but with rounded lateral keels, antical and postical surfaces practically ecarinate, apex broad, beak obsolete: ♂ inflorescence occupying a short branch; bracts few, imbricated. (Name from κύστις, a bladder, and *Lejeunea*, referring to the strongly inflated lobule.)

When *Cystolejeunea* is compared with *Cheilolejeunea*, as represented by such a robust species as *C. jamaicensis*, the two genera are seen to have much in common. They agree in texture and color, in the shape of the lobe, in the general peculiarities of the leaf-cells, in the absence of ocelli, in the underleaves, in the simple female branch and in the flattened perianth. Aside from its lobules, however, *Cystolejeunea* differs in its convex leaf-lobes and in its beakless perianth. Of course the more delicate species of *Cheilolejeunea* offer still other points of difference.

Macrolejeunea is a genus of somewhat doubtful validity. Its type species is *M. pallescens* (Mitt.) Schiffn.,* known only from the Andes of Ecuador. In this plant the female branch is simple, and the perianth is destitute of both beak and keels, characters which it shares with *Cystolejeunea*. It differs, however, in its general habit, in its pointed leaves and in its delicate texture, agreeing in all these respects with the genera *Taxilejeunea* and *Hygrolejeunea*. *Euosmolejeunea* and *Trachylejeunea* both differ from *Cystolejeunea* in their five-keeled perianths.

Cystolejeunea lineata (Lehm. & Lindenb.)

Jungermannia lineata Lehm. & Lindenb. in Lehmann, Pug. Plant. **4**: 53. 1832.

Lejeunea lineata Lehm. & Lindenb. in G. L. & N. Syn. Hep. 371. 1845.

Lejeunea (*Macro-Lejeunea*) *lineata* Spruce, Hep. Amaz. et And. 225. 1884.

Lejeunea (*Cheilolejeunea*) *lineata* Steph. Hedwigia **27**: 287. 1888.

Cheilolejeunea lineata Schiffn. in Engler & Prantl, Nat. Pflanzenfam. 1^3: 124. 1893.

Macrolejeunea lineata Schiffn. Bot. Jahrb. **23**: 588. 1897.

* Engler & Prantl, Nat. Pflanzenfam. 1^3: 124. 1893 (= *Lejeunea pallescens* Mitt. Hook. Jour. Bot. and Kew Gard. Misc. 3: 360. 1851).

Pale- or bright-green, becoming brownish with age, occasionally forming small depressed mats but usually growing mixed with other hepatics: stems 0.17 mm. in diameter, sparingly branched, some of the branches with smaller leaves than the stem but not microphyllous; rhizoids few: leaves imbricated, the lobe falcate-ovate when explanate, 1 mm. long, 0.85 mm. wide, antical margin strongly curved except at the very base, arching across the axis, postical margin straight or slightly incurved, apex rounded to obtuse, margin entire or indistinctly angular-sinuate; lobule 0.35 mm. long, 0.2 mm. wide, abruptly contracted in the outer part, keel forming an angle of about 90° with the postical margin of the lobe; cells of lobe averaging 18 μ at the margin, 32 × 21 μ in the middle and 37 × 21 μ at the base, convex on both surfaces, outer wall strongly thickened especially in the middle of the cell, trigones large, triangular with bulging sides, intermediate thickenings rare, found mostly in basal region of lobe: underleaves distant, broadly orbicular, 0.4 mm. long, 0.5 mm. wide, bifid about one third with broad, erect, acute to apiculate divisions separated by an acute sinus; margin as in the leaves: inflorescence dioicous: ♀ branch usually with a single rudimentary leaf and a single underleaf in addition to the bracts and bracteole; bracts spreading, the lobe convex, falcate-obovate, 0.85 mm. long, 0.5 mm. wide, rounded at the apex, margin as in the leaves, lobule oblong or lanceolate, 0.4 mm. long, 0.08 mm. wide, free portion short, rounded to acute at the apex; bracteole free, oblong, 0.8 mm. long, 0.4 mm. wide, narrowed toward the base, rounded at the apex and very shortly bidentate or retuse; perianth more than half exserted, obovate in outline, 1.4 mm. long, 0.9 mm. wide, narrowed toward the base, truncate or slightly retuse at the apex with rounded outer angles, surface smooth or nearly so: ♂ inflorescence with bracts in from two to four pairs; bracts imbricated, strongly inflated, shortly bifid with a strongly arched keel, both lobes rounded at the apex; bracteoles one or two at the base of the spike, shortly and variously bifid; antheridia single or in pairs: mature sporophyte not seen (PLATE 3).

On trees. Puerto Rico, without definite localities, *Schwanecke, Sintenis.* El Yunque, *Evans* (*38 p. p., 46 p. p., 62, 99.*) Also known from several of the Lesser Antilles, namely: St. Kitts, *Breutel, Britton & Cowell;* Guadeloupe, *L'Herminier;* St. Vincent and Dominica, *Elliott.* Apparently through an error, the type locality of the species was given as "Bourbon," and it has also been recorded from Java. In all probability, however, its range is restricted to the West Indies.

Even in a sterile condition, there is no Puerto Rico species with which *C. lineata* is likely to be confused. Its comparatively large size, its convex lobes with blunt apices, its peculiar lobules, its convex leaf-cells with large trigones, its small underleaves, bifid and with sharp divisions, will all serve to distinguish it. Fruiting specimens are further distinguished by the beakless and flattened perianth borne on a short and simple branch.

PYCNOLEJEUNEA

The characters which have been relied upon in separating *Pycnolejeunea* from *Cheilolejeunea* are the robustness of the plants, the closely imbricated leaves, the elongated lobules, the large underleaves and the five-keeled perianth. All of these characters, with the exception of that drawn from the lobules, are fairly constant and will usually serve to distinguish the genus not only from *Cheilolejeunea*, but also from *Rectolejeunea*. The lobule, however, varies greatly in length and is sometimes scarcely longer than broad. In the structure of the apical tooth and in the position of the hyaline papilla the lobule agrees with that found in *Rectolejeunea*.

The selection of the type species of *Pycnolejeunea* is beset with the same difficulties as in *Cheilolejeunea*. The first species mentioned by Spruce is *L. contigua* Nees;* the first species which he describes is also called *L. contigua*, but the specimens from which this description is drawn are now recognized as the type of *Pycnolejeunea Spruceana* Schiffn.;† the first species which Schiffner lists is *P. macroloba* (Mont.) Schiffn.‡ Under the circumstances the writer suggests that *P. Spruceana* be considered the type, since this is really the first species which Spruce describes.

Pycnolejeunea is confined to tropical and subtropical regions. It attains its highest development in the East Indies and neighboring islands, but has numerous representatives in America. At the present time only one species is definitely known from Puerto Rico. Most if not all of the species grow on bark, sometimes in pure mats, sometimes in admixture with other hepatics.

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* Hep. Amaz. et And. 247. 1884.

† Bot. Jahrb. **23**: 583. 1897.

‡ Engler & Prantl, Nat. Pflanzenfam. 1^3: 124. 1893 (= *Lejeunea macroloba* Mont. Ann. Sci. Nat. Bot. II. **19**: 260. 1843).

The species belonging to this genus are nearly all robust and vary in color from dull-green to glaucous or whitish-green. They are never glossy and many of them become brownish with age or upon drying. The prostrate stems are more or less closely adherent to the substratum and branch irregularly; some of the branches are similar to the stem, but they are more often short and limited in growth, and in certain species microphyllout branches are to be observed. The leaves are closely imbricated (plate 2, figure 9). The lobes are convex and falcate, although sometimes in a very slight degree; they vary in shape from ovate to subrotund; the apex is broad and rounded, and the margin varies from entire to minutely crenulate. The leaf-cells are more or less convex; their walls are firm, sometimes with distinct trigones (figure 13), sometimes presenting the appearance of being uniformly thickened. Ocelli occur in many species, but not in all; they are sometimes scattered (figures 9, 10), but are usually at the base of the lobe. The lobule varies in outline from broadly ovate to long-rectangular and is built up on the same plan as in *Rectolejeunea*, with the hyaline papilla proximal in position. The underleaves are closely imbricated; they are nearly always orbicular in general outline, but are sometimes broader than long; they are bifid with pointed divisions, and their margins are commonly entire.

The female branch is variable in length, but is usually long. The flowers innovate on one or on both sides, the innovations themselves being often again floriferous. The bracts are about as large as the leaves on robust and sterile axes, but are larger than the leaves which immediately precede them on the female branch. They are unequally bifid and usually distinctly complicate, in many cases showing a narrow and entire wing along the keel (figures 19, 20). The lobe is broad and rounded, and the narrow lobule varies from acute to rounded even on a single specimen. The bracteole is larger than the underleaves and less deeply bifid. The perianth is obovate in outline and is sharply five-keeled, at least in the upper part (figures 9, 21, 22). The apex is broad and usually rounded, the beak being short but distinct. The antheridial spike usually occupies a short branch (figure 23), but is sometimes terminal on a longer branch; the antheridia, so far as observed, occur in pairs.

PYCNOLEJEUNEA SCHWANECKEI (Steph.) Schiffn.

Lejeunea macroloba laxior Hampe & Gottsche, Linnaea **25**: 356. 1852. Not *Lejeunea macroloba* Mont. 1843.

Lejeunea (*Pycnolejeunea*) *Schwaneckei* Steph. Hedwigia **27**: 289. *pl. 13, f. 28.* 1888.

Pycnolejeunea Schwaneckei Schiffn. Bot. Jahrb. **23**: 594. 1897.

Glaucous-green, becoming brownish with age, growing in loose depressed mats, often in company with other hepatics; stems 0.17 mm. in diameter, prostrate and loosely adherent to the substratum, irregularly pinnate, an occasional branch long, unlimited in growth and with normal leaves but most of the branches very short, microphyllous, and concealed by the leaves of the higher axis, all of the branches obliquely to widely spreading: leaves more or less densely imbricated, the lobe convex and often revolute at the apex, broadly falcate-ovate, 0.85–1 mm. long, 0.7–0.85 mm. wide, antical margin straight or slightly incurved near the base, then strongly outwardly curved to the apex, arching partially or wholly across the axis, postical margin revolute and curved, apex broad and rounded, whole margin slightly and indistinctly crenulate from projecting cells; lobule narrowly ovoid-cylindrical, 0.5 mm. long, 0.12 mm. wide (0.17 mm. wide when explanate), inflated throughout, keel straight or nearly so, roughened from projecting cells, free margin straight or nearly so, involute nearly or quite to the apex, sinus lunulate, apical tooth blunt or subacute, not curved, papilla in a scarcely evident depression; cells of lobe convex on both free surfaces, averaging 15 μ at the margin, 22 μ in the middle and 28 μ at the base, walls thickened, especially the antical wall, trigones large, triradiate, sometimes confluent or separated by very narrow pits, intermediate thickenings occasional, circular in outline; ocelli mostly four to nine, scattered but mostly confined to the postical half of lobe and covered over by the preceding leaf, averaging 46 × 35 μ: underleaves imbricated, broadly orbicular, 0.35 mm. long, 0.4 mm. wide, broadly cuneate at the base and sometimes bearing a rudimentary disc in the radicelliferous region, bifid one fifth to one third with erect divisions, obtuse to subacute at the apex, and a narrow sinus; cells and margin as in the leaves: inflorescence dioicous: ♀ inflorescence borne on a leading branch, innovating on one side or more rarely on both sides, the innovations sterile or again floriferous; bracts obliquely spreading, complicate, the lobe falcate-ovate, convex, 1.2 mm. long, 0.85 mm. wide, apex broad, margin as in the leaves, keel narrowly winged, lobule ovate to obovate, rounded to subacute at the apex, 0.75 mm. long, 0.35 mm. wide; bracteole

connate on one side with bract, broadly ovate to obovate, 0.85 mm. long, 0.6 mm. wide, apex broad, retuse to shortly bidentate, margin as in the leaves; perianth immersed in the involucre or slightly exserted, obovoid, 1 mm. long, 0.6 mm. wide, narrowed toward the base, broad and rounded at the apex and with a very short beak, sharply five-keeled especially toward apex, surface roughened from projecting cells especially along the keels: ♂ inflorescence occupying a short branch or more rarely terminal on a microphyllous branch; bracts mostly in from three to six pairs, closely imbricated, strongly inflated, shortly and subequally bifid with an arched keel, the lobe rounded, the lobule sometimes subacute or apiculate at the apex; bracteoles one or two at the base of the spike, similar to the underleaves but smaller; antheridia in pairs: mature sporophyte not seen (PLATE 2, FIGURES 9–23).

On bark of trees. North slope of the Luquillo Mountains, *Heller* (*4739*). El Yunque, *Evans* (*73*). The type specimens were collected in Puerto Rico by *Schwanecke*. The species has also been found in Jamaica, *Underwood*, *Maxon*, *Evans*.

An interesting feature of *P. Schwaneckei* is found in the peculiar microphyllous branches, which are usually abundantly developed on both male and female individuals (figures 9, 11, 12). These branches are nearly always completely concealed by the leaves and are therefore invisible when a stem is viewed from above. Although so short, each branch bears from three to seven pairs of closely imbricated leaves with corresponding underleaves. The leaves are very much smaller than ordinary leaves and measure about 0.2 mm. in length; they are shortly bifid, the lobe being but little larger than the lobule, and the keel is strongly arched. The lobe is suberect and rounded at the apex, and its margin is vaguely angular-dentate. The lobule is inflated and blunt at the apex, being similar in this respect to normal lobules. The small underleaves are essentially like those found on the stem. Apparently these microphyllous branches increase the water-holding power of the plants, partly by means of their protected position, partly by means of the close imbrication of all their parts. They apparently assist also in affixing the plants to the substratum, since rhizoids are abundantly produced by their underleaves.*

*Similar microphyllous branches occur in *Radula pycnolejeuneoides* Schiffn., from the island of Amboina (Nova Acta Acad. Caes. Leop.-Carol. **60**: 247. *pl. 13, f. 1–7.* 1893). They were originally described as male spikes, but their true nature was soon pointed out by Goebel (Flora **77**: 432. *pl. 8, 9. f. 3, 4.* 1893).

The characters which separate *P. Schwaneckei* from the closely related *P. macroloba* are tabulated by Stephani, and little of importance has since been written on either species. Schwanecke's original material represents a somewhat laxer form than most of the specimens recently collected, although connected with them by intergrading conditions. If well-developed forms of the species are compared with typical *P. macroloba*, it will be found that some of the differential characters relied upon by Stephani are inconstant. The plants, for example, are equally robust in the two species, and the texture of *P. Schwaneckei* is really the denser of the two; there is but little difference in the branching; the leaves in both species are strongly imbricated, and the same is true of the underleaves; the leaf-cells do not show the differences which are ascribed to them, and there is no constant difference in the position of the antheridial spike. The other differential characters which Stephani notes seem to be trustworthy. The inflorescence in *P. Schwaneckei*, as he remarks, seems to be always dioicous, while in *P. macroloba*, the inflorescence is normally autoicous, although unisexual individuals sometimes occur. The keel of the leaves in *P. macroloba* is nearly always distinctly arched, and the postical margin of the lobe, where the free margin of the lobule meets it, is plane or nearly so, although the apex of the lobe tends to be revolute. In *P. Schwaneckei* the keel is straight, and the lobe is revolute along the postical margin as well as at the apex. The underleaves of *P. macroloba*, also, are more deeply bifid, and their divisions are usually more acute.

In addition to these differences, it may be noted that the leaf-cells in *P. macroloba* are a trifle larger than in the other species, averaging 25 μ in the middle of the lobe. The local thickenings in the cell-walls are about the same size, but appear more distinct because separated from one another by broader pits and showing much less tendency to become confluent. The ocelli, also, are fewer, only two to four, and less distinct. According to Schiffner,* the cell-walls in *P. Schwaneckei* are uniformly thickened, an ap-

* Lebermoose der Forschungreise S. M. S. Gazelle, 32. 1890. The species is here recorded from the island of Amboina, but apparently through error, since Schiffner makes no mention of it in his Conspect. Hepat. Archip. Indici, published in 1898.

pearance due to the frequent confluence of the local thickenings, leading to an obliteration of the pits. The bracts and perianths are very similar in the two species, but the bracteoles afford another difference. In *P. macroloba* these are distinctly bidentate at the apex, the teeth being acute and often connivent; in *P. Schwaneckei* the bracteoles are either undivided or shortly or irregularly bidentate with blunt teeth. In *P. macroloba*, finally, microphyllous branches are rare, and many plants fail to develop them altogether.

For assistance in the preparation of this paper the writer is especially indebted to Professor Lindau, of Berlin, and Herr Stephani, of Leipzig. Through their kindness it has been possible to examine the type specimens of *Lejeunea Berteroana*, *Pycnolejeunea Schwaneckei* and several of their allies. *Lejeunea decidua*, *L. versifolia* and *L. emarginuliflora* were based on specimens distributed in exsiccatae, and these have also been studied by the writer. The type specimens of *L. phyllobola* and *L. lineata* have not been consulted.

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Explanation of plates 1-3

The figures were drawn by the writer and, with a very few exceptions, prepared for publication by Miss Hyatt.

PLATE 1

Cheilolejeunea decidua (Spruce) Evans. 1. Part of prostrate stem, with two branches, postical view, × 32. 2. Cells from middle of lobe, × 250. 3. Cells from antical margin of lobe, × 190. 4. Apex of lobule, × 190. 5. Apex of underleaf-division, × 190. 6. Male inflorescence, postical view, × 40. 7. Part of an ascending branch, from which most of the lobes have fallen away, postical view, × 32. 8. A detached lobe with three leafy shoots growing from it, × 32. 9. A leafy shoot without underleaves, from another detached lobe, × 50. The figures were all drawn from specimens collected in Florida by Small & Carter (*1370 p. p.*, *1408*).

Rectolejeunea flagelliformis Evans. 10. Female branch with perianth and floriferous innovation, postical view, × 32. 11. Part of sterile stem, postical view, × 32. 12. Two leaves, antical view, × 32. 13. Cells from middle of lobe, × 250. 14. Cells from antical margin of lobe, × 190. 15. Apex of lobule, × 190. 16. Base of underleaf, × 190. 17. Apex of underleaf-division, × 190. 18, 19. Bracts, × 32. 20. Bracteole, × 32. 21, 22. Apices of bracteoles, × 32. 23. Apex of flagelliform branch, postical view, × 32. 24. Modified leaf from flagelliform branch, with young leafy shoot growing from it, × 32. 25. Part of modified underleaf, × 190. The figures were all drawn from Cuban specimens collected by Underwood & Earle (*346*, *521*).

PLATE 2

Rectolejeunea emarginuliflora (Gottsche) Evans. 1. Part of a stem with a female inflorescence, postical view, × 45. 2. Part of a sterile stem, postical view, × 35. 3. Part of a stem from which most of the leaves have fallen away, postical view, × 45. 4, 5. Bracts, × 45. 6. Bracteole, × 45. 7. Detached leaf with a protonema and a leafy shoot growing from it, × 45. 8. Detached leaf with several protonemata, × 45. Figs. 4–6 were drawn from the type specimen (Hep. Cubenses); the remaining figures were drawn from the specimens collected by A. A. Heller (*4741 p. p.*).

Pycnolejeunea Schwaneckei (Steph.) Schiffn. 9. Part of a stem with a perianth and a microphyllous branch, postical view, × 25. 10. Part of stem, antical view, × 25. 11. Microphyllous branch, antical view, × 45. 12. The same, postical view, × 45. 13. Cells from middle of lobe, × 265. 14. The same in cross-section, × 200. 15. Cells from antical margin of lobe, × 200. 16. Cells from base of lobe, with an ocellus, × 200. 17. Apex of lobule, × 200. 18. Apex of underleaf-division, × 200. 19. Bract and bracteole, × 25. 20. Bract, × 25. 21. Cross-section of perianth at about the middle, × 35. 22. Cross-section of perianth near the apex, × 35. 23. Male inflorescence, antical view, × 35. The figures were all drawn from specimens collected in Jamaica by the writer (*99*).

PLATE 3

Cystolejeunea lineata (Lehm. & Lindenb.) Evans. 1. Part of sterile stem, postical view, × 35. 2. Part of stem with male inflorescence, postical view, × 35. 3. Explanate leaf, postical view, × 35. 4. Leaf, antical view, × 35. 5. Cells from middle of lobe, × 265. 6. The same in cross-section, × 200. 7. Cells from antical margin of lobe, × 200. 8. Apex of lobule (showing reflexed papilla), × 200. 9, 10. Apices of underleaf-divisions, × 200. 11. Leaf from female branch, × 35. 12. Underleaf from female branch, × 35. 13–15. Bracts, × 35. 16, 17. Bracteoles, × 35. 18. Perianth, × 35. 19. Cross-section of perianth, × 35. The figures were all drawn from specimens collected by the writer (*38 p. p.*, *46 p. p.*).

New species of Uredineae—IV

JOSEPH CHARLES ARTHUR

The following new species are from various parts of the United States, Canada, Mexico and West Indies. They were found in part among new collections sent for determination and in part among herbarium material which has long been known under other names. For the new material I am especially indebted to Messrs. E. W. D. Holway, C. L. Shear, G. P. Clinton, LeRoy Abrams and C. H. Demetrio. In the present descriptions I have used instead of the terms spermogonium, aecidium, uredo and teleutosorus, the new terms pycnium (*πυκνός*), aecium (*αἰκία*), uredinium (uredo) and telium (*τέλος*), which were recently proposed by the writer * as more convenient and uniform. Their application is sufficiently self-evident to make further explanation unnecessary.

Uromyces Dolicholi sp. nov.

II. Uredinia amphigenous, scattered, round, 0.2–0.5 mm. across, soon naked, pale cinnamon-brown, pulverulent, ruptured epidermis inconspicuous; urediniospores globose, 18–21 μ in diameter, wall cinnamon-brown, medium thick, 1.5–2 μ, minutely and closely echinulate, pores 4, equatorial.

III. Telia amphigenous, scattered, round, 0.2–0.5 mm. across, soon naked, cinnamon-brown, pulverulent, ruptured epidermis inconspicuous; teliospores oblong, or oblong-lanceolate, 10–15 by 26–32 μ, narrowed toward both ends, wall pale golden-brown, smooth, thin, 1 μ or less, thicker at apex, 3–6 μ, with nearly colorless umbo; pedicels slender, half length of spore, nearly colorless.

On *Dolicholus texanus* (T. & G.) Vail (*Rynchosia texana* T. & G.), San Angelo, Texas, October 19, 1904, *C. L. Shear* (host determined by E. L. Greene).

A strongly marked species. To the unaided eye there is little difference between the uredinia and telia, both being produced in abundance, but under the microscope the teliospores appear much

* ARTHUR, J. C. Terminology of the spore-structures in the Uredinales. Bot. Gaz. 39: 219–222. 1905.

paler than the urediniospores, and both are unlike the usual leguminous species of *Uromyces*.

Puccinia Dolichi sp. nov.

II. Uredinia hypophyllous, irregularly scattered, round, small, 0.25 mm. across, soon naked, chestnut-brown, pulverulent, ruptured epidermis inconspicuous; urediniospores globose, small, 19–23 μ in diameter; wall chestnut-brown, rather thin, 1.5–2 μ, minutely echinulate, pores 3, or rarely 4, equatorial.

III. Telia not seen; teliospores in the uredinia, oblong, very large, 30–40 by 50–70 μ, acute or acuminate at the apex, rounded or obtuse at base, slightly or not constricted at septum; wall semi-opaque, chocolate-brown, thick, 3 μ, thickened and prolonged into a prominent, lighter-colored rostrum at apex, 10–15 μ, surface coarsely verrucose, with very low tubercles, smoother or smooth on the rostrum; pedicel colored next the spore, 6–12 μ thick, once length of spore.

On *Dolichos reticulatus* Hochst., Aguacate (province of Habana), Cuba, March 23, 1903, *E. W. D. Holway*.

Puccinia Fimbristylidis sp. nov.

II. Uredinia chiefly hypophyllous and caulicolous, oblong, 0.5–1 mm. long, soon naked, yellow, pulverulent, ruptured epidermis noticeable; urediniospores broadly elliptical or globoid, 15–20 by 18–23 μ, wall brownish-yellow, medium thick, 1.5 μ, sparsely and evenly echinulate with low points, pores 2, equatorial and opposite.

III. Telia chiefly hypophyllous and caulicolous, subepidermal, covered with the brown epidermis, irregularly oblong, 0.1–0.5 mm. long, or punctiform, compound, each component sorus round, surrounded by abundant, dark-brown, hyphal stroma; teliospores oblong, 16–19 by 34–50 μ, slightly constricted at septum, acute or obtuse at apex, somewhat narrowed at base, wall smooth, golden-brown, medium thick, 1–1.5 μ, thicker at apex, 4–9 μ; pedicel very short, colored.

On *Fimbristylis polymorpha* Boeckl. (type), Cuernavaca, State of Morelos, Mexico, Sept. 27, 1898, *E. W. D. Holway 3227*; *F. Holwayana* Fernald, Chapala, State of Jalisco, Mexico, Sept. 9, 1899, *Holway 3443*; *Fimbristylis sp.*, Mayaguez, Porto Rico, April 13, 1904, *G. P. Clinton 48*; the last with uredinia only.

This species differs materially from *Puccinia Eleocharidis* Arth. in the telial characters, although the urediniospores have a close

resemblance. In *P. Eleocharidis* the stroma is absent, and the telia are simple, while the teliospores are more rounded above. The urediniospores of both species differ conspicuously from those of *Uredo superior* Arth. in size. All three species occur in Porto Rico.

Puccinia Pattersoniana sp. nov.

II. Uredinia epiphyllous, oblong, soon naked; urediniospores ellipsoid, 21–26 by 28–34 μ, wall golden-yellow, thick, 3 μ, sparingly and prominently verrucose, pores 3 (?), approximately equatorial.

III. Telia epiphyllous, intercostal, oblong-linear, soon naked, ruptured epidermis noticeable; teliospores oblong, somewhat angular, 16–22 by 30–37 μ, slightly or not constricted at septum, rounded or obtuse at both ends; wall golden-brown, uniformly thin throughout, 1 μ, appearing smooth when wet, finely and closely striate when dry: pedicel delicate, 5-7 μ thick, once to twice length of spore, nearly colorless.

On the rough, or concave side of leaves of *Agropyron spicatum* (Pursh) Rydb., Sandcoulee, Cascade Co., Montana, July, 1888, *F. W. Anderson.*

The urediniospores of this species somewhat resemble those of *Puccinia Agropyri*, but the teliospores are very unlike any known North American rusts on grasses, especially in the uniformly thin walls and surface striation. The specific name is given in recognition of the services rendered to mycology by Mrs. Flora W. Patterson, curator of the cryptogamic herbarium of the United States Department of Agriculture.

Cronartium Comptoniæ sp. nov.

II. Uredinia hypophyllous, scattered or somewhat gregarious, round, very small, about 0.1 mm. across, dehiscent by a central rupture, soon wide open and naked, pulverulent; peridia rather firm, cells polygonal, at the sides with walls uniformly thin, about 1 μ, at the top with the inner walls greatly thickened, up to 10 μ; urediniospores oval or obovate, 16–21 by 23–31 μ, wall colorless, rather thick, 2.5 μ, sparsely and finely echinulate.

III. Telia hypophyllous, filiform, 40–100 μ thick, 0.5–2 mm. long; teliospores fusiform-oblong, 13–17 by 28–56 μ, obtuse at both ends; walls nearly colorless, smooth, thin, 1–1.5 μ.

On *Comptonia peregrina* (L.) Coult. (*C. asplenifolia* Gaertn.), Egg Harbor, N. J., Sept. 7, 1874, *J. C. Arthur* (type); Belle Plain, N. J., Oct. 15, 1902, *C. L. Shear* (in Ellis & Everhart,

Fungi Columbiani, *no. 1724*); Newton, Mass., without date, *W. G. Farlow* (in Ellis, North American Fungi, *no. 285*); *Myrica Gale* L., Orono, Me., Oct. 12, 1900, *P. L. Ricker* (in Ellis & Everhart, Fungi Columbiani, *no. 1482*).

The much thickened inner walls of the uredinial peridium and the thin-walled teliospores especially distinguish this species. It has been reported on the first named species from North Carolina, New York, and Vermont, in addition to the above data.

Hyalopsora pellaeicola sp. nov.

II. Uredinia amphigenous, scattered, irregularly round or oblong, bullate, 0.3–0.7 mm across, dehiscent by apical rupture, soon naked, pulverulent, golden-yellow, ruptured epidermis noticeable, peridia very delicate and difficult to detect; urediniospores globoid or obovate-globoid, 17-22 by 23-30μ, wall colorless, thin, 1μ, usually appearing twice as thick, minutely verrucose, or even echinulate-verrucose, pores obscure, equatorial.

III. Telia unknown.

On *Pellaea andromedaefolia* (Kaulf.) Fée, San Gabriel Cañon, Los Angeles County, California, March 13, 1903, *LeRoy Abrams 3125* (type); *Cryptogramme Stelleri* (Gmel.) Prantl, (*Pellaea gracilis* Hook.), Red Rock, Michigan, June 28, 1884, *J. Macoun* (host determined by L. M. Underwood), and Decorah, Iowa, August 1882, *E. W. D. Holway*.

The large globoid and very thin-walled urediniospores sharply distinguish this species from those on *Phegopteris* and *Cystopteris*.

CERATELIUM gen. nov.

Pycnia and aecia unknown. Uredinia with peridium, centrally dehiscent, urediniospores borne singly on pedicels, wall nearly colorless, echinulate, pores obscure, contents colored. Telia with spores united into a short column, or globoid mass, arising at first from bed of the uredinia, waxy; teliospores one-celled, wall smooth, nearly or quite colorless.

Ceratelium Canavaliae sp. nov.

II. Uredinia hypophyllous, gregarious on reddish-brown spots, crowded, small, 0.1–0.2 mm. across, bullate, rupturedepidermis inconspicuous, centrally dehiscent; peridia delicate, cells polygonal, inner walls slightly if any thicker than the outer walls; urediniospores broadly ellipsoid or globoid, 18–23 by 26–34μ;

wall medium thick, 1–2μ, pale-yellowish, sparsely and minutely echinulate, pores obscure.

III. Telia hypophyllous, columns scarcely extending beyond the peridia, about as long as broad; teliospores cylindrical or polygonal, small, 6–9 by 13–17μ, wall smooth, thin, 0.5–0.8μ, colorless.

On *Canavalia ensiformis* DC., Mayaguez, Porto Rico, April 16, 1904, *G. P. Clinton 87*.

An especially interesting rust on account of the combination of a melampsoraceous fungus with a leguminous host. The collection shows an abundance of telia. They are less conspicuous than the uredinia, and need to be studied by means of sections. The possession of a peridium in the uredinia at once widely separates the species from any of the usual leguminous rusts. The telia resemble those of *Dietelia*, only are much smaller. The species possesses a uredinial stage, however, which is absent in *Dietelia*. Except in the length of the telial column, there is considerable resemblance to *Cronartium*.

Coleosporium Eupatorii sp. nov.

II. Uredinia chiefly hypophyllous, scattered, round, small, 0.25 mm. across, early naked, pulverulent, yellow fading to white, ruptured epidermis somewhat noticeable; urediniospores short ellipsoid, or globoid, 15–20 by 22–27μ; wall colorless, medium thick, 2–2.5μ, half formed by the rather large, irregular, deciduous tubercles.

III. Telia unknown.

On *Eupatorium macrophyllum* L., El Yunque, Baracoa, Cuba, March 12, 1903, *E. W. D. Holway* (type); *Eupatorium* sp., Volcan Mombacho, Department of Granada, Nicaragua, February 20, 1903, *C. F. Baker 2461*, communicated by E. W. D. Holway.

The species is distinguished from *Coleosporium Steviae* Arth. by larger uredinia and smaller urediniospores. The walls of the spores are thicker, and the tubercles larger and noticeably irregular in form, not round and papilliform as in *C. Steviae* and many other species.

Uredo Dichromenae sp. nov.

II. Uredinia hypophyllous, scattered, oblong, 0.2–0.5 mm. long, covered by the overarching epidermis, and having an apparent peridium of hyphae; urediniospores elliptical, or broadly obovate,

18–23 by 22–35 μ, wall light yellow, medium thick, 1.5–2 μ, sharply and sparsely echinulate, pores obscure.

On *Dichromena ciliata* Vahl, Mayaguez, Porto Rico, April 13, 1904, *G. P. Clinton* (type); *D. radicans* Cham. & Schl., near Troy, Jamaica, May, 1903, *L. M. Underwood* (hosts determined by N. L. Britton).

Both collections are much parasitized, making it difficult to see the structure of the sorus. All sections show what seems like a peridium, enclosing the sorus after the manner of that in *Uredinopsis*. If it is a true hyphal structure, however, the exact construction cannot be made out.

Aecidium Falcatae sp. nov.

O. Pycnia amphigenous, in small groups, punctiform, honey-yellow, wholly immersed, subepidermal, in vertical section globose, 100–125 μ in diameter.

I. Aecia hypophyllous, gregarious in rather large, circular or irregular groups, crowded; peridia short, cylindrical, margin somewhat recurved, finely lacerate; aeciospores globoid, 18–23 by 19–25 μ; wall rather thin, 2 μ, rather coarsely verrucose.

On *Falcata comosa* (L.) Kuntze (*Amphicarpa monoica* Ell.), Decorah, Iowa, June 21, 1881, *E. W. D. Holway* (type); *Apios Apios* (L.) MacM. (*A. tuberosa* Moench), Ames, Iowa, June 17, 1879, *W. A. Thomas*, and Iowa City, Iowa, June, 1886, *Thomas H. Macbride*.

This aecial stage differs slightly from that on various species of *Phaseolus*, *Strophostyles*, and *Vigna*, in having more prominent aecia, with more globoid and rougher aeciospores, and is therefore described as a separate species from *Uromyces appendiculatus* Ung., to which it has usually been referred. As it is not known to be followed by any other stage on the same hosts, it is assumed to be a heteroecious species. Besides occurring in Iowa it is reported from Illinois, Minnesota, Wisconsin, and Nebraska.

Aecidium Triostei sp. nov.

O. Pycnia epiphyllous, in small groups, punctiform, honey-yellow, subepidermal, seen in vertical section globose, 90–130 μ in diameter.

I. Aecia hypophyllous, in circular groups, 5 mm. or more across, not crowded; peridium at first hemispherical, low, margin

erect, erose; aeciospores globoid, 18–22 μ in diameter; wall thin, 1 μ thick, pale-yellow, minutely and closely verrucose.

On *Triosteum angustifolium* L., Perryville, Missouri, May, 1884, *C. H. Demetrio.*

No aecial or other form of rust is recorded on this host, or any closely related one. It is probably a heteroecismal species.

Aecidium Cardui sp. nov.

O. Pycnia epiphyllous, in small groups, immersed, inconspicuous, punctiform, subepidermal, globose, 130–180 μ in diameter.

I. Aecia hypophyllous, crowded in circinating groups, 3–5 mm. across, on discolored spots; peridia short, cylindrical, margin erect, erose; aeciospores globoid, small, 15–18 by 16–20 μ; wall nearly colorless, very thin, 0.5–1 μ, very minutely granulose.

On *Carduus Hookerianus* (Nutt.) Heller (*Cirsium Hookerianum* Nutt.), Sandcoulee, Montana, July 28, 1887, *F. W. Anderson 82.*

The common rust on various thistles, which extends across the continent and is especially common westward, is *Puccinia Cirsii* Lasch., and is a species having uredinia and telia, but no aecia. *P. suaveolens* (Pers.) Rostr. is a similar species found only on *Carduus arvensis*, while *P. Cnici* Mart., occurring on *Carduus lanceolatus*, has aecia of a wholly different and peculiar sort. There appears, therefore, to be no recognized species of rust on thistle to which this Aecidium can be referred, and it is consequently described as an independent form. Whether it belongs with an autoecious or heteroecious species can not be stated. The collector only included leaves of the host, and did not supply a specific name. The material has been submitted to Dr. P. A. Rydberg, of the New York Botanical Garden, who gives the above name, but with some degree of uncertainty, due to the very scanty material.

Aecidium Argithamniae sp. nov.

O. Pycnia epiphyllous, few in orbicular groups, not crowded, punctiform, honey-yellow becoming dark-brown, conspicuous, immersed, in section globoid, large, 150–175 μ across.

I. Aecia hypophyllous, on discolored spots in orbicular or annular groups, 2–5 mm. across, not crowded, cylindrical, short, margin erect, erose or lacerate; aeciospores globoid, 15–18 by

18–21 μ; wall nearly colorless, very thin, 1 μ or less, very minutely verrucose, appearing smooth.

On *Argithamnia Schiediana* Müll. Arg. (?), Trinidad, State of Hidalgo, Mexico, May 25, 1904, *C. G. Pringle*, communicated by E. W. D. Holway.

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The genus Stenochlaena

Lucien Marcus Underwood

In no portion of *Synopsis Filicum* does the lack of coördination of the work of other authors manifest itself more strikingly than at page 412 under *Acrostichum sorbifolium*, where the elaborate work of Fée, which had appeared twenty-two years previously, is made to pass for naught, and his seventeen species of *Lomariopsis* are reduced to synonymy. While the elder Hooker was writing the *Species Filicum*, of which the *Synopsis* is a revised and abbreviated digest, Kunze and, later, Mettenius, were describing ferns independently at Leipzig, as was also Presl at Prague, and Fée at Strasburg. The work at each of these centers appears to have gone on in practical independence and without much comparison or coördination. Such species as happened to come to Kew appear to have been reviewed, and the others were often reduced to synonymy with no specimen at hand. Some were never mentioned. The visitation of other centers seems rarely if ever to have been practiced. Presl had no successor to his studies and his still unmounted fern collection exists to-day at Prague, apparently never visited by modern European fern students or monographers. At Berlin, Kuhn was the lineal successor of Mettenius, as Fournier at Paris was the successor of Fée. At Berlin, in addition to the collection of Willdenow, most of the types of Kaulfuss, Kunze, Klotzsch, Mettenius and Kuhn may be seen, and at Paris most of those of Lamarck, Bory, Desvaux, Fée and Fournier are at the museum of the Jardin des Plantes, but neither Hooker nor his successors at Kew consulted them, and to this present year of grace, continental European fern students have never taken the trouble to coördinate them with the Kew collection, but have continued to work on in the same old independent ways.

In attempting to elucidate the American species of *Stenochlaena*, the fact that Hooker had attributed one of our West Indian species to nearly all parts of the tropical world * made it necessary to

* "West Indies to Peru and South Brazil; Fiji, Samoa, New Caledonia, Philippines, Malaccas, Cochin China, Seychelles, Mascaren Isles, Angola, Guinea Coast." — Syn. Fil. 412.

review the entire genus. During the past summer, while visiting the collections at Vienna, Prague, Berlin, Paris and Kew, the specimens representing this genus were examined comparatively and the following revision is the result of this first synoptical study of a genus based on the materials of all the great fern collections of the world. How different the result appears from that based on the study of the material at a single center may be seen by comparing the present revision with the treatment of the same group in *Synopsis Filicum*, where most of the species of other authors are ruthlessly reduced to synonymy under *Acrostichum sorbifolium*, originally from the West Indies. To the twenty-three Old World species here recognized should be added ten or more which represent the American development of the genus and which will be given a separate treatment. Five species appear in *Synopsis Filicum;* of these three reappear without change; three are here described as new, and the remainder represent species either unknown to the authors of *Synopsis Filicum* or unfortunately reduced to synonymy by them.

The genus *Stenochlaena* forms a rather natural group of non-indusiate ferns whose nearest relatives are to be found in the dimorphous species of *Stegania* R.Br. (*Lomaria* Willd.) as suggested in the name (*Lomariopsis*) given to one section of the genus when monographed by Fée sixty years ago. In fact the species with narrow pinnae in the sporophyls have often been described in the genus *Lomaria*, as those with wider pinnae were supposed to have a corresponding relation to *Acrostichum*. At least four genera have been established from among the species, the name *Stenochlaena* being the oldest for any member of the group. In recent papers Dr. Christ still maintains the genera *Lomariopsis* and *Stenochlaena* as distinct, but this seems less rational than to unite them as sections of one genus. It is true that we have two types of venation represented in the group: the first with the lateral veins springing from the midrib, and the second with accessory veins parallel and adjacent to the midrib with the lateral veins springing from them. Pinnae jointed to the rachis occur in species with both types of venation. The species with the second type have spiny leaves, while those with the first type have a normally cartilaginous margin to the pinnae. With these slight dif-

ferences, it seems better, therefore, to recognize only a single genus with four fairly marked sections which may be distinguished as follows:

Synopsis of the sections of Stenochlaena

Lateral veins springing from a vein lying parallel to the midrib and occasionally connecting with it; margins of the pinnae spiny.

Sporophyls simply pinnate. — § **Eustenochlaena.**

Sporophyls normally bipinnate. — § **Cafraria** Presl.

Lateral veins springing direct from the midrib; pinnae not spiny.

Climbing stems spiny, not scaly, naked; leaves trimorphous. — § **Teratophyllum** Mett.

Climbing stems not spiny, usually more or less densely scaly. — § **Lomariopsis** Fée.

The species of the first three sections are all confined to the tropics of the Old World. Those of the section *Lomariopsis* are divided between the tropics of the Old and New worlds, approximately in the ratio of three to two.

§ 1. EUSTENOCHLAENA

The genus *Stenochlaena* was founded by John Smith in 1841 and was based on *Acrostichum scandens* * as a type. The species closely allied to this, then, must constitute the section *Eustenochlaena*, notwithstanding the fact that there has been a different use for the term.† There are three species of this section, one of which has a wide range and presents considerable variation from its various stations. The other two species have quite a limited range. They may be easily separated by the following synopsis:

Pinnae of the sporophyls narrow, 3 mm. wide. — 3. *S. palustris.*

Pinnae of the sporophyls wider, 5–10 mm. wide.

Pinnae 3.5–4 cm. wide, rounded-obtuse at the base; pinnae of the sporophyls narrow, 5 mm. wide. — 2. *S. Milnei.*

Pinnae 3 cm. wide, truncate at the base; pinnae of the sporophyls wider, 10 mm. wide. — 1. *S. laurifolia.*

1. STENOCHLAENA LAURIFOLIA Presl, Epim. Bot. 164. 1851 (type from Luzon, *Cuming 226*).

Acrostichum laurifolium Hook. Sp. Fil. 5: 250. 1864. — Syn. Fil. 412.

RANGE: Philippine Islands.

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* SMITH (Jour. Bot. Hook. 3: 401. 1841) wrongly attributes this species to Linnaeus. His context, however, makes clear the species intended. Later he included members of other sections in the genus (Jour. Bot. Hook. 4: 149. 1841).

† DIELS, Die natürlichen Pflanzenfamilien 1⁴: 251. 1899; where the term *Eustenochlaena* is used to include also species of *Lomariopsis* Fée.

2. **Stenochlaena Milnei** sp. nov.

Creeping stems unknown; leaves pinnate; pinnae 6–7- (or more) jugate, rigid, coriaceous, rounded-obtuse at base, nearly sessile; 20 cm. or more long, 3–3.5 cm. wide, the margins thickly beset with small spines, the apex long-acuminate; veins close, 17–18 spaces to the centimeter, simple or occasionally forked at or near the base; surfaces smooth and shining; sporophyls pinnate; the pinnae about 9-jugate, 25 cm. or more long, 5 mm. wide, tapering at the apex, inclined to be revolute when dry; rachises pallid, smooth, rather stout.

SOLOMON GROUP: *Milne 518* (type), K; *ibid. 590*, K.

NEW GUINEA: *Honkmann*, K (fragment); *Armit*, K (sporophyl only).

ADMIRALTY ISLANDS: *Moseley* (Challenger Exped.), K.

S. Milnei is represented at Kew by fragmentary materials which do not show the stem characters; it is, however, sufficiently differentiated from the variable *S. palustris*, and especially from *S. laurifolia*, under which Hooker cites the type, to justify separation even on present materials. Specimens have been seen only at Kew.

3. STENOCHLAENA PALUSTRIS (Burm.) Beddome, Suppl. Ferns India 26. 1876.

Polypodium palustre Burm. Fl. Ind. 234. 1768. (Type from Ceylon.)

Onoclea scandens Sw. Syn. Fil. 112, 309. 1806. (Change of Burmann's specific name without warrant.)*

Lomaria scandens Willd. Sp. Pl. **5**: 293. 1810.

Lomaria? juglandifolia Presl, Rel. Haenk. **1**: 52. 1825. (Type from the Philippines, *Haenke*.) †

Lomaria? Haenkeana Presl, Rel. Haenk. **1**: 53. 1825. (Type from Sorzogon, Luzon, *Haenke*.)

Stenochlaena scandens J. Sm. Jour. Bot. Hook. **3**: 401. 1841.

Stenochlaena Blumeana Presl, Epim. Bot. 163. 1851. (Type from Tranquebar, *Bottler*.)

Stenochlaena Haenkeana Presl, Epim. Bot. 165. 1851.

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* Swartz, moreover, has his references to Burmann sadly mixed and attributes the species to Linnaeus who apparently never mentioned it. John Smith copied Swartz' error in establishing the genus *Stenochlaena*.

† Like many other plants in this work Presl reported this originally from Mexico but corrected it in his herbarium and in his later writings.

Acrostichum scandens Hook. Sp. Fil. **5**: 249. 1864.—Syn. Fil. 412. 1868.

Lomariopsis palustris Mett. Ann. Mus. Lug.-Bat. **4**: 294. 1869.

ICON.: Rheede, Hort. Malab. **12**: *pl. 35*. 1703; Burmann, Thes. Zeyl. *pl. 46*. 1737; Rumphius, Herb. Amboin. **6**: *pl. 31*. 1750; Schkuhr, Crypt. Gewächse *pl. 106, 107*; Hooker & Bauer, Gen. Fil. *pl. 105 B*; Fée, Mém. Foug. **5**: *pl. 5 A. f. 2*; Beddome, Ferns Southern India *pl. 201*.

RANGE: India from Punjab?, Sikkim and Ceylon, to Malacca, Java, Sumatra, Borneo, the Philippines, to Queensland, Fiji, Samoa, and Tonga Islands.

§ 2. CAFRARIA Presl.

This group was set apart by Presl as a section in 1851.* It agrees with *Eustenochlaena* in venation and in the marginal spines of the pinnae, but differs in the bipinnate sporophyl, a character wholly insufficient to separate it as a genus. Fée founded the genus *Lomariobotrys* on the same group in 1852.

A single species:

4. **Stenochlaena tenuifolia** (Desv.)

Lomaria tenuifolia Desv. Berl. Mag. **5**: 326. 1811. (Type from Madagascar.)

Lomaria Meyeriana Kunze, Linnaea **10**: 509. 1836. (Type from Natal?, "inter Omtendo et Omsamculo," *Drege*.)

Stenochlaena Meyeriana Presl, Epim. Bot. 166. 1851.

Lomariobotrys Meyeriana Fée, Mém. Foug. **5**: 46. *pl. 5A*. 1852.

Lomariobotrys tenuifolia Fée, Mém. Foug. **5**: 46. 1852.

Acrostichum Meyerianum Hook. Garden Ferns *pl. 16*. 1862.—Sp. Fil. **5**: 250. 1864.

Acrostichum tenuifolium Baker, Syn. Fil. 412. 1868.

ICON.: Hooker, *loc. cit.*; Fée, *loc. cit.*

RANGE: Africa from the Cape of Good Hope and Natal to Nossibé, Madagascar, Mauritius, and the Comoro Islands.

There are specimens in the Kew herbarium in which there are some simply pinnate sporophyls as well as the normally bipinnate ones, said to have grown on the same plant.

* In publishing *Lomariobotrys*, Fée adds the date 1851, citing *Cafraria* Presl, Epim. Bot. 166. This seems to fix the date of the Epim. Bot. as 1851 rather than 1852 (cf. Bull. Torrey Club **32**: 590, *note*). This also enables us to cite 1852 instead of "1850–52" for Fée's fifth Memoir.

§ 3. TERATOPHYLLUM Mett. (in part).

In 1869 Mettenius established the genus *Teratophyllum* based on *T. aculeatum* (*Lomaria aculeata* Bl.) and *T. articulatum* (*Polybotrya articulata* J. Sm.). The latter species forms the type of the genus *Arthrobotrya* J. Sm., and appears to be a valid genus. In this group the rootstock is spiny and naked, the veins are free, the pinnae are articulated to the rachis, and the leaves are trimorphous. In addition to the ordinary foliage leaves which are simply pinnate like those of the other sections of the genus, there are accessory bipinnate or even tripinnate leaves which often lie more closely appressed to the surface over which the plant climbs. A good illustration of this feature may be seen in Karsten, Ann. Bot. Jard. Buitenzorg **12**: *pl. 14*, copied in Velenovsky's Vergleichende Morphologie der Pflanzen 200, *f. 128*. 1905. Such dissected leaves are not unknown in other ferns, occurring even in some of the *Cyatheaceae*.

There are three species known at present, all confined to the East Indian region both continental and insular. They may be distinguished as follows:

Foliage green; pinnae 1.5–2.5 cm. wide, nearly sessile. 5. *S aculeata.*
Foliage pink or violet when dry; pinnae 1 cm. or less wide.
  Pinnae obtuse or truncate at the base, short-stalked; sporophylary pinnae as long as the sterile. 6. *S. gracilis.*
  Pinnae cuneate at the base, long-stalked; sporophylary pinnae twice the length of the sterile. 7. *S. Williamsii.*

Besides the above there are indications of a fourth species, from Perak, with green foliage, the pinnae stalked (1–1.5 cm.), subcoriaceous, and 2.5–3 cm. wide. Specimens exist at Kew.

5. STENOCHLAENA ACULEATA (Blume) Kunze, Bot. Zeitung **6**: 142. 1848.

Lomaria aculeata Blume, Enum. Pl. Jav. 205. 1828. (Type from Java.)

Lomariopsis spinescens Fée, Mém. Foug. **2**: 71. *pl. 33. f. 1.* 1844–5. (Based on the above with an unwarranted change of of specific name.)

Lomariopsis ludens Fée, Mém. Foug. **2**: 70. *p. 30.* 1844–5. (Type from Singapore, *Gaudichaud.*)

Davallia achillaefolia Wall. Cat. n. 248; Hooker, Sp. Fil. **1**: 195. *pl. 56 D.* 1846. (Type from Penang, *Wallich.*)

Teratophyllum aculeatum Mett. Ann. Mus. Bot. Lug.-Bat. **4**: 296. 1869.

Acrostichum aculeatum Racib. Pter. Fl. Buitenzorg 53. 1898.

ICON.: Fée, *loc. cit.*; Hooker, *loc. cit.*; Karsten, Ann. Jard. Bot. Buitenzorg **12**: *pl. 14*. 1893.

RANGE: Perak, Tenasserim, Java, Borneo, and the Philippines. Usually appears in herbaria in a sterile condition. A var. *inermis* Mett., without spines on the rootstock, has also been described (Mett. *loc. cit.* 297).

6. STENOCHLAENA GRACILIS (Blume) Kunze, Bot. Zeitung **6**: 142. 1848.

Lomaria gracilis Blume, Enum. Pl. Jav. 205. 1828.

Acrostichum gracile Racib. Pter. Fl. Buitenzorg 53. 1898.

RANGE: Java.

7. **Stenochlaena Williamsii** sp. nov.

Stems pink, 3–8 mm. thick, widely creeping, densely rooting below, spiny above; foliage leaves scattered, about 6 cm. apart, up to 60 cm. long, the stalks pink with a slight tinge of brown, slightly fibrillose, with a slight ridge and groove along the upper side, pinnate; the pinnae deciduous, stalked (5 mm. or more), lanceolate, 12–15 cm. long, 1.5 cm. wide, cuneate tapering at the base, acuminate at the apex, the margin slightly repand or entire, the surfaces smooth, the midrib prominent, reddish, with occasional fibrils; veins distinct, close (about 15 spaces to 1 cm.), simple or forked; sporophyls pinnate, the pinnae deciduous, long-stalked (8–10 mm.), 25–28 cm. long, 1.5–2 mm. wide, with conspicuous midrib; secondary foliage leaves 1–2 cm. long (or larger in young plants), bipinnatifid, membranous, in growth appressed to the substratum.

PHILIPPINES: Lamao River, Mt. Mariveles, Prov. Bataan, Central Luzon, alt. 120 meters, *Williams 684*. Type in the herbarium of the New York Botanical Garden.

Growing on trees. "Young plants with finely dissected leaves." Unfortunately few of the secondary foliage leaves were secured, so that their exact relation to the others is not clear in the type specimen. The species differs from *S. aculeata* in its narrow pink pinnae, the color appearing in every part of the plant when dry. From *S. gracilis* it differs in its cuneate acute bases of the pinnae and the elongate pinnae of the sporophyls.

§ 4. LOMARIOPSIS Fée

The numerous members of this section, which were so summarily crowded into one species by Hooker, form a natural group in which free veins rising directly from the midribs, scaly climbing rootstocks rarely if ever armed with prickles, and pinnae continuous with the rachis form the most obvious characters. The species are widely distributed and have thereby become notably diverse in the various parts of the earth where they now appear. As a rule the individual species have very clearly marked characters combined with a narrow geographic range. It is therefore somewhat simpler to treat of the great continental regions separately. The American species will form the subject of a separate paper. The accompanying figures of normal lateral pinnae, drawn natural size, will show something of the diversity of leaf-form in the genus in the Old World.

1. THE SPECIES OF AFRICA AND ITS ISLANDS

Willemet (1796) was the first to describe a species of this group from Africa under the name of *Osmunda pollicina*. Later species have been separated by Bory, Fée, Kunze, Mettenius, Kuhn, and Baker, who have each added a single species to the flora, and an eighth is here published as new. The species range from Sierra Leone to Fernando Po on the west coast and across the continent to the islands of Mauritius and Madagascar. Their differential characters will become apparent in the following synopsis:

Pinnae truncate at base.

Pinnae 5 cm. or less long, those of the lowest third of the leaf gradually decreasing to mere auricles. 11. *S. decrescens.*

Pinnae 15 cm. long, only the lowest 2–3 pairs slightly smaller. 16. *S. Mannii.*

Pinnae cuneate or rounded-obtuse at the base, never truncate.

Lateral pinnae under 7 cm. long, rounded-obtuse at the base.

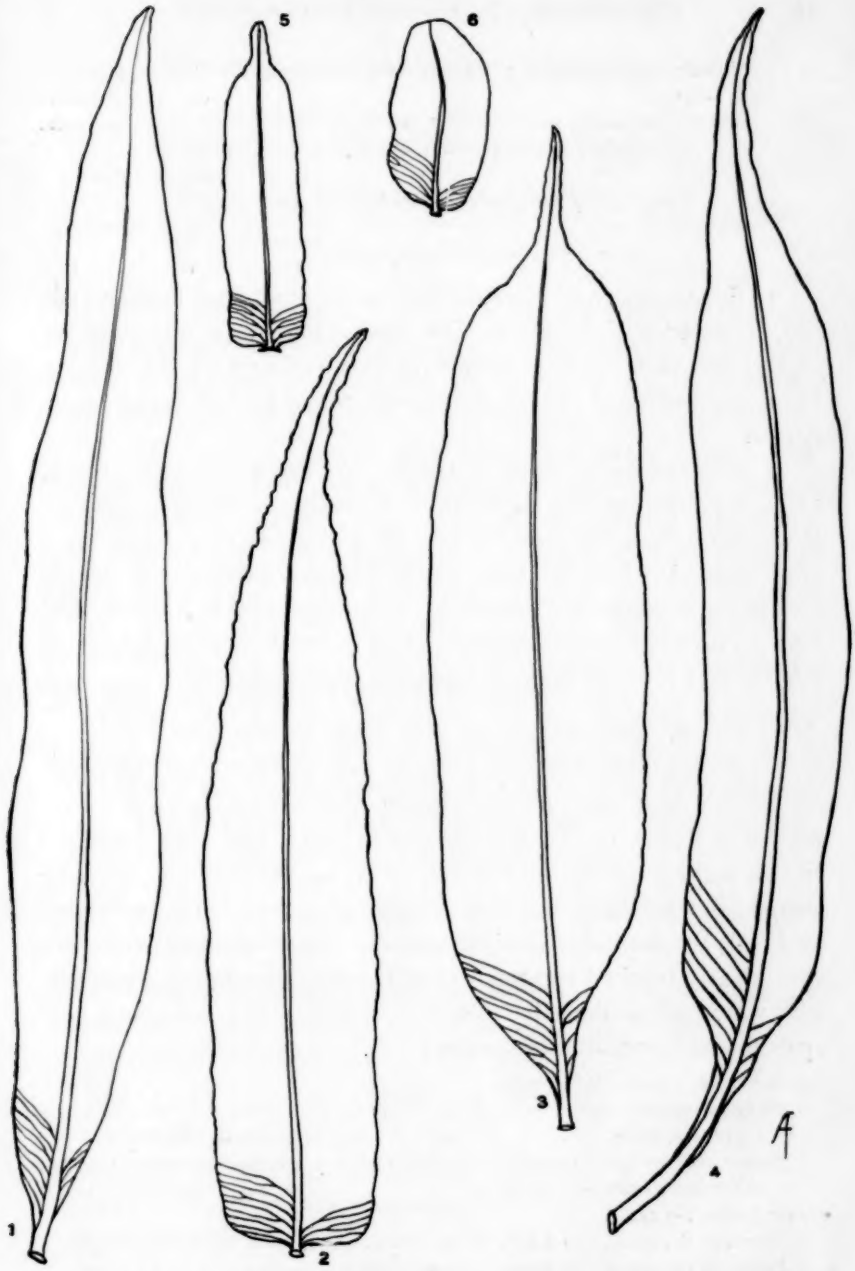
Pinnae pointed at the apex, 7 by 2 cm.; pinnae of the sporophyls 7.5 cm. long by 5 mm. wide. 20. *S. pollicina.*

Pinnae rounded at the apex, suboval.

Pinnae of the sporophyls 10–12 mm. long by 2–3 mm. wide, obtuse at the apices. 9. *S. buxifolia.*

Pinnae of the sporophyls 3 cm. long by 4–5 mm. wide, pointed at the apices. 15. *S. lomarioides.*

Lateral pinnae 10–15 cm. or more long, cuneate at the base.



Some of the species confused under *Stenochlaena sorbifolia*. Normal lateral pinnae, natural size. 1. *S. Pervillei*. 2. *S. Mannii*. 3. *S. guineensis*. 4. *S. Brackenridgei*. 5. *S. decrescens*. 6. *S. lomarioides*.

Pinnae broadly elliptic, 3–3.5 cm. wide, abruptly narrowed to an acuminate apex. 12. *S. guineensis.*

Pinnae lanceolate, scarcely over 2 cm. wide, tapering to an acuminate apex.

Pinnae of the sporophyls short-stalked, 2 mm. or less wide. 19. *S. Pervillei.*

Pinnae of the sporophyls long-stalked, 4–6 mm. wide. 23. *S. variabilis.*

Species inquirendae

1. Specimens from Namuli, Makua country, East Tropical Africa, collected by *Last* (Herb. Kew.) have only sterile leaves, 9–10-jugate, but these do not agree with those of any known species. More information is necessary before locating a ninth species from Africa.

2. *Polypodium* (?) *binerve* Hook. Sp. Fil. **4**: 176. *pl. 273B.* 1862, is placed by Mr. Baker as "one of the abnormal conditions of *Acrostichum sorbifolium*" (Syn. Fil. 323). It may represent a good species when its sporophyls become known. It has of course no relation to *Polypodium* other than that it is a fern, and none to *Stenochlaena sorbifolia*, but is either a distinct species or less likely a juvenile state of some one already known.

2. THE SPECIES OF THE EAST INDIAN AND AUSTRALIAN REGIONS AND OF THE PACIFIC ISLANDS

Of the eight species belonging to this region, three were described in Fée's original monograph in 1844, two were described by Carruthers in *Flora Vitiensis* and appear entirely to have escaped the notice of the Kew botanists, and one each was added by Presl, Brackenridge, and Mettenius. Most of the species are very clearly marked and not one of them approaches *S. sorbifolia*, with which all of them have been confused. The following synopsis will differentiate the species:

Pinnae narrow, 1.5 cm. or less wide.

Pinnae serrulate; veins stopping short of the margin; pinnae of the sporophyls 1.5–2 mm. wide. 13. *S. Hügelii.*

Pinnae entire or barely repand; veins running into a cartilaginous margin; pinnae of the sporophyls 4–5 mm. wide. 14. *S. leptocarpa.*

Pinnae wider, 2–5 cm.

Pinnae of the sporophyls 2 mm. or less wide. 8. *S. Brackenridgei.*

Pinnae of the sporophyls wider, 4–8 mm. wide.

Pinnae of the sporophyls 8–15 cm. long, short-stalked.

Foliar pinnae 2 cm. wide, tapering at the apex. 17. *S. Novae-Caledoniae.*

Foliar pinnae 3.5–5 cm. wide, abruptly acuminate at the apex.
10. *S. cochinchinensis.*
Pinnae of the sporophyls 20–30 cm. long, long-stalked (2 cm.).
Pinnae of the sporophyls gradually tapering at the apex.
22. *S. Smithii.*
Pinnae of the sporophyls abruptly acuminate at the apex.
Pinnae narrow, about 2 cm. wide. 18. *S. oleandrifolia.*
Pinnae wider, 3–3.5 cm. wide, few-jugate.
21. *S. Seemannii.*

The last two species are quite near to each other in form and general appearance and may represent only two phases of the same species. Since the meager materials represented in herbaria are insufficient, it is better to keep them apart, as they have already been established, awaiting further collection in the South seas. With the strong possibility of distinctness, this is a more rational proceeding than to unite them. This is a far different proposition from separating doubtful things in the event of a possibility of specific distinctness. The geographic range of the two species is practically the same, which further decreases the probability of specific distinctness. As a species or group they are entirely distinct from any other members of the section.

Species excludenda

STENOCHLAENA FEEGEENSIS Brack. Filices U. S. Expl. Exped. 78. *pl. 11. f. 1.* 1854. (Type from the Fiji Islands, *Wilkes Exped.*)

The synonymy and distribution of the species of § *Lomariopsis* of the Old World are given in an alphabetical series:

8. **Stenochlaena Brackenridgei** (Carruth.) [FIGURE 4.]
Lomariopsis Brackenridgei Carruth. Fl. Vit. 373. 1871. (Type from the Fiji Islands.)
RANGE: Known only from its type locality.

9. **Stenochlaena buxifolia** (Kunze).
Acrostichum buxifolium Kunze, Die Farrnkr. **1**: 171. *pl. 72.* 1845. (Type from Madagascar.)
ICON.: Kunze, *loc. cit.*
RANGE: Known only from Madagascar.

Polypodium orbiculatum Poir. Encyc. Méth. Bot. **5**: 525 (type locality, Java) is referred to this species as a synonym by Kuhn,

but in the absence of any type specimen and with a widely different type locality it is much safer to leave the matter in abeyance.

10. **Stenochlaena cochinchinensis** (Fée).

Lomariopsis cochinchinensis Fée, Mém. Foug. **2**: 66. *pl. 26.* 1844–5. (Type from Cochin China, *Herb. Mus. Paris.**)

ICON.: Fée, *loc. cit.*

RANGE: Cochin China; known only from the original collection by Gaudichaud.

11. **Stenochlaena decrescens** (Baker) [FIGURE 5.]

Acrostichum decrescens Baker, Syn. Fil. 412. 1868. (Type from the Cameroons, West Tropical Africa, *Mann 1391.*)

RANGE: Known only from its type collection (Kew).

12. **Stenochlaena guineensis** (Kuhn) [FIGURE 3.]

Lomariopsis guineensis Kuhn, Fil. Afr. 53. 1868. (Type from Fernando Po, *Mann 139.*)

Acrostichum guineense Carruth. Cat. Afr. Pl. Welwitsch **2**: 276. 1901.

Foliar pinnae 10 × 3 cm.; sporophyllary pinnae 10 cm. × 4 mm.

RANGE: Fernando Po, St. Thomas, Congo, Angola and Sierra Leone. Sterile fragments from the last named region at Kew have much larger pinnae 17 × 4 cm., but are not otherwise distinct.

13. **Stenochlaena Hügelii** (Presl) Fée in herb. Vindob. [FIGURE 9.]

Lomariopsis Hügelii Presl, Epim. Bot. 263. 1851. (Type from New Zealand, *Hügel.*)

Lomariopsis sorbifolia var. resectum [*sic*] Christ in Warburg, Monsunia **1**: 56. 1900. (Type from Cairns, North Queensland, *Warburg 19286.*)

This clearly marked species, which naturally has no near resemblance to *S. sorbifolia* of the American tropics, was well characterized by its author in the corrections to the text of *Epimeliae Botanicae*, and for this reason has eluded discovery for a long time. A long manuscript description under a new name by F. Mueller appears in the Kew herbarium with specimens from Rockingham

* We were unable to find the type in Paris collected by Gaudichaud, but there is a cotype in the herbarium at Berlin.

Bay, Queensland. Warburg's specimens represented at the Berlin herbarium differ mainly in having somewhat shorter pinnae with their upper basal angle more truncate than in Presl's plant. The venation and margins of the pinnae suggest *Plagiogyria*, but there is apparently no indusium. It forms a clearly marked species from a region inhabited by no other species of this section.

14. **Stenochlaena leptocarpa** (Fée).

Lomariopsis leptocarpa Fée, Mém. Foug. **2**: 69. *pl. 29.* 1844–5. (Type from the Philippines, *Cuming 132.*)

Lomaria spectabilis Kunze, Bot. Zeitung **6**: 144. 1848. (Type from Pangarango, Java, *Zollinger 3130.*)

Lomariopsis spectabilis Mett. Fil. Hort. Bot. Lips. 22. 1856.

Acrostichum spectabile Racib. Pter. Fl. Buitenzorg 54. 1898.

ICON: Fée, *loc. cit.*

RANGE: Java and the Philippines.

We have not seen Fée's own specimen of this species, which is now in storage with the Cosson herbarium at the Paris Museum. This number of Cuming in the general collection of the herb. Mus. Paris, does not agree with Fée's excellent figure, but is clearly *S. Smithii.* Original specimens from Mettenius' herbarium agree perfectly with Fée's plate, as does Raciborski's recent excellent description.

15. **Stenochlaena lomarioides** (Bory) [FIGURE 6].

Acrostichum lomarioides Bory, Belang. Voy. Bot. 21. *pl. 2.* 1833. (Type from Ile de France, *Belanger.*)

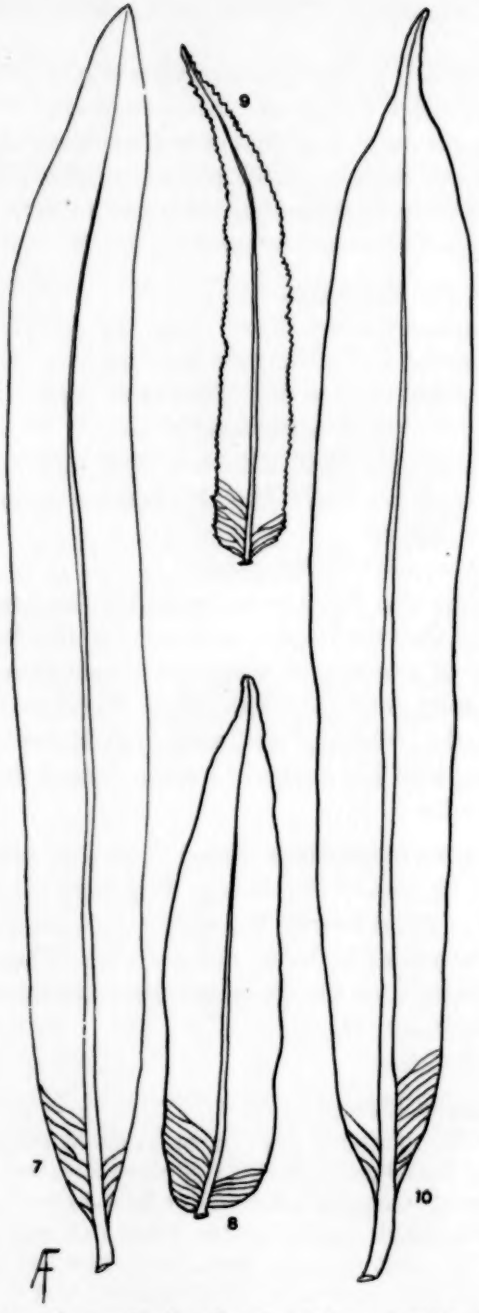
Lomariopsis Boryana Fée, Mém. Foug. **2**: 68. 1844–5. (Specific name changed from the above without apparent warrant.)

ICON.: Bory, *loc. cit.*

RANGE: Bourbon.

16. **Stenochlaena Mannii** sp. nov. [FIGURE 2.]

Stems stout, climbing, 1.5 cm. or more in diameter, densely covered with dark-brown scales; stipes scattered, stout, 20–30 cm. long, densely covered with similar dark-brown scales; sterile leaves pinnate, about 19-jugate, the pinnae closely placed, up to 17 cm. long by 2 cm. or more wide, the lowest two or three pairs slightly shorter, the upper gradually reduced to 3–5 cm. long, the terminal similar but larger (8 cm. long); pinnae rounded-truncate at the base, gradually tapering to an acute point, margins undu-



Some of the species confused under *Stenochlaena sorbifolia*. Normal lateral pinnae, natural size. 7. *S. Novae-Caledoniae*. 8. *S. pollicina*. 9. *S. Hügelii*. 10. *S. oleandrifolia*.

late, midribs with occasional scales; rachis strongly margined above, more or less scaly throughout; sporophyls pinnate, the pinnae 26-jugate, gradually diminishing above and below, the longest (medial) 11 cm. long by 5–7 mm. wide at the rounded base, tapering gradually to a point; rachis similarly scaly and margined above.

FERNANDO PO: 5,000 ft., 1860, *Mann 354* (type), K (three sheets) *ibid.* 3,000 ft. *446*, K.

CAMEROONS: *Kalbreyer 188*, K (slightly smaller; sterile leaves 28-jugate); *H. H. Johnston 146*, K (still smaller; sterile leaves only, 24-jugate.)

17. **Stenochlaena Novae-Caledoniae** (Mett.) [FIGURE 7.]

Lomariopsis Novae-Caledoniae Mett. Ann. Sci. Nat. IV. **15**: 58. 1861. (Type from Poila, New Caledonia, *Vieillard 1529*.)

RANGE: Known only from its type collection. The species resembles *S. Perrillei* in the form of the pinnae, but differs widely in the sporophyls.

18. STENOCHLAENA OLEANDRIFOLIA Brack. Filices U. S. Expl. Exped. 75. 1854. (Type from the Fiji Islands, *Wilkes*.) [FIGURE 10.]

RANGE: Fiji Islands and New Hebrides.

19. **Stenochlaena Pervillei** (Mett.) [FIGURE 1.]

Lomariopsis Pervillei Mett.; Kuhn, Fil Afr. 53. 1868. (Type from the Seychelles Islands, *Perville 98*.)

RANGE: Known only from the type locality.

20. **Stenochlaena pollicina** (Willemet) [FIGURE 8].

Osmunda pollicina Willemet, Ann. Bot. Usteri **6**[18]: 61. 1796. (Type locality, Mauritius, Mt. Pollex?.)

Lomaria fraxinea Willd. Sp. Pl. **5**: 294. 1810. (Type locality, Mauritius, and also cites *Osmunda pollicina* as a synonym!)

Lomaria integrifolia Kaulf.; Sprengel, Syst. Veg. **4**: 63. 1827. (Type from Mascarine Islands.)

RANGE: Mauritius, Bourbon, Madagascar, Mascarene Islands.

21. **Stenochlaena Seemannii** (Carruth).

Lomariopsis Seemannii Carruth. Fl. Vit. 373. 1873. (Type from the Fiji Islands, *B. Seemann 712*).

RANGE: Fiji Islands and New Hebrides.

22. **Stenochlaena Smithii** (Fée).

Lomariopsis Smithii Fée, Mém. Foug. **2**: 71. *pl. 33. f. 2; pl. 53.* 1844–5. (Type from the Philippines, *Cuming 143.*)

ICON: Fée, *loc. cit.*

RANGE: Philippine Islands.

23. **Stenochlaena variabilis** (Willd.).

Lomaria variabilis Willd. Sp. Pl. **5**: 294. 1810. (Type from Mauritius.)

Osmunda trifrons Bory, Voyage **3**: 163. 1804. (*Nomen nudum.*)

Lomariopsis variabilis Fée, Mém. Foug. **2**: 70. *pl. 31. 32.* 1844–5.

Lomariopsis cuspidata Fée, Mém. Foug. **2**: 68. *pl. 27.* 1844–5. (Type from Mauritius.)

ICON: Fée, *loc. cit.*

RANGE: Known only from Mauritius.

We cannot separate Fée's two species, of which he gives excellent plates; the type number of his *L. cuspidata* (*Sieber 22*) is also cited under *L. variabilis!*

COLUMBIA UNIVERSITY.

Studies in North American Polygonaceae — II

JOHN KUNKEL SMALL

Eriogonum xanthum sp. nov.

Perennial (section *Flava*), dwarf, closely pale-pubescent. Stems (caudices) closely tufted, densely leafy, the lower portions densely clothed with the persistent leaf-bases: leaves numerous, crowded; blades spatulate, 1–2.5 cm. long, obtuse, somewhat floccose and greenish above, more closely pubescent and gray beneath, rather slender-petioled: scapes 3–5 cm. tall, simple, pubescent, like the upper surface of the leaf-blades: bracts spatulate, quite similar to the leaves, but usually 1–1.5 cm. long: involucres nearly sessile, capitate, turbinate, ultimately ribbed, about 4 mm. long; lobes triangular, about one fourth as long as the tube: calyxes yellow, becoming 8 mm. long, including the stipe-like base, which is about 1.5 mm. long, silky-pubescent without; lobes spatulate or the outer ones pandurate-spatulate: filaments copiously villous below the middle: ovary sparingly pubescent at the top; styles sparingly pubescent at the base: achenes about 5.5 mm. long.

Collected on Mt. Harvard, Colorado, August 17, 1896, by *C. L. Shear, no. 3789* (type), and on Gray's Peak, Colorado, August, 1873, by Mr. Woolson.

Related to both *Eriogonum flavum* and *E. aureum*, but differing from both of them in its longer slender base of the perianth and the glabrous, persistent leaf-bases.

Eriogonum umbelliferum sp. nov.

Perennial, with woody branching rootstocks (section *Umbellata*), bright-green. Stems represented by short caudices: leaves crowded on the caudices; blades spatulate to elliptic or oval, 1–4 cm. long, or rarely longer, glabrous or nearly so at maturity, except the floccose-ciliate margins, slender-petioled: scapes 6–28 cm. tall, each topped with a 2–6-rayed umbel, which is subtended by a whorl of foliaceous bracts: peduncles mainly 1–2 cm. long and closely pubescent during anthesis, larger and thinly pubescent at maturity: involucres campanulate, sometimes becoming turbinate-campanulate, 2–2.5 mm. long, the lobes fully as long as the tube and strongly reflexed: calyxes yellow or sometimes red-tinged in age, about 8 mm. long at maturity, including the stipe-

like base, which is 2–2.5 mm. long; lobes spatulate to oblong-obovate, the inner becoming markedly longer than the outer: filaments copiously villous from above the middle to the base: ovary sparingly pubescent at the top; styles pubescent at least below the middle: achenes about 5 mm. long, the beak fully as long as the body, which is decidedly constricted at the base.

The type was collected west of Ouray, Colorado, September 9, 1901, by *L. M. Underwood, no. 177 b.* The species is apparently common in Colorado and has been collected in two other States, viz.:

WYOMING: Fort Bridger, July, 1873, *Porter.* Elk Mt., July, 1899, *Little & Stanton 171.* Fort Steele, May and June, 1901, *Tweedy 4396.* Copperton, June, 1901, *Tweedy 4395.* UTAH: Wasatch Mts., August, 1879, *Jones 1411* and August, 1900, *Stokes.*

This species differs from its nearest relative, *Eriogonum umbellatum,* chiefly in its longer and more slender-stalked calyx and glabrous or nearly glabrous leaves.

Eriogonum Tetraneuris sp. nov.

Perennial (section *Lachnogyna*), silvery-gray and silky-tomentose. Stems (caudices) tufted, very densely leafy, 1–4 cm. long, the older portions thickly clothed with old dilated leaf-bases: leaves crowded; blades elliptic to oblong, 1–3 cm. long, acute or acutish, paler and more densely pubescent beneath than above; petioles as long as the blades or shorter, ciliate and dilated below: scapes 1–1.5 dm. tall, conspicuously more densely pubescent near the top than below, simple or rarely branched, the branch subtended by a leaf-like bract: involucres sessile, capitate, subtended by lanceolate or triangular bracts, campanulate, about 3.5 mm. long, silky; lobes ovate, obtuse, about one third as long as the tube: calyxes lemon-yellow, about 6 mm. broad, silky without; lobes oblong or oblong-cuneate, the inner rather broader than the outer: filaments sparingly villous at the base: ovary densely pubestent; styles glabrous: achenes not seen.

Collected near Pueblo, Colorado, May 15, 1900, by *P. A. Rydberg & F. K. Vreeland, no. 6324.*

Related to *Erigonum lachnogynum* but with capitate inflorescence, and in this resembling *E. villiflorum.* The involucres are slightly longer than those of *E. lachnogynum* and the calyx-lobes are not contracted below the middle. The pubescence of the

upper part of the peduncle and that of the involucres is more appressed and silky than the pubescence of *E. lachnogynum*.

Eriogonum orthocaulon sp. nov.

Perennial with woody rootstock and caudices which are densely leafy at the ends (section *Heterosepala*). Leaves usually numerous; blades typically oval, mostly 1–1.5 cm. long, or rarely smaller, densely felty-pubescent, but usually rather more thinly so above than beneath, terminating long curved or somewhat curled petioles: scapes mainly 1–3 dm. long, simple, floccose, each terminating in a head of several involucres, which is subtended by minute or thick-subulated bracts: involucres turbinate, sometimes angled and thus turbinate-obpyramidal, about 7 mm. long, prominently ribbed, floccose, the lobes mostly broader than long and much shorter than the tube: calyxes ochroleucous, becoming 4.5–5 mm. long, the outer sepals suborbicular to ovate-orbicular, the inner linear-cuneate to pandurate, about as long as the outer: filaments slightly pubescent at the base: ovary and styles glabrous: achenes not seen.

The type was collected at Rifle, Garfield county, Colorado, June 23, 1900, by *Geo. E. Osterhout, no. 2125*. Specimens have been collected elsewhere as follows:

IDAHO: Foothills, June, 1892, *Mulford*. Blue Lakes, June 2, 1893, *Palmer 62*. Idaho Falls, July 4, 1901, *Merrill & Wilcox 782*. UTAH: Salt Lake City, May, 1869, *Watson 1016*. ALBERTA: Crow Nest Pass, August, 1897, *Macoun 24480* and *24481*.

This species is related to *Eriogonum ovalifolium* and *E. ochroleucum*, but from both of these it may be distinguished by the large involucres.

Eriogonum coloradense sp. nov.

Perennial (section *Capitata*). Depressed stems branched at the base; branches tufted, 1–4 cm. long, clothed with the persistent leaf-bases: leaves crowded; blades narrowly spatulate to linear-spatulate, 2–5 cm. long, blunt, slightly revolute, webby-pubescent above or at length glabrous, densely white lanate-tomentose beneath, except the prominent midrib, narrowed into petiole-like bases which are dilated and scarious at the base: peduncles simple, mostly surpassed by some of the leaves, relatively stout, lanuginous, the pubescence becoming floccose: involucres in heads terminating the peduncle, campanulate, about 5 mm. long, thinly woolly without; lobes suborbicular or nearly reniform, barely one

third as long as the tube: calyxes pink or pinkish, fully 4 mm. long at maturity; lobes blunt, the outer broadly ovate or orbicular-ovate, the inner smaller than the outer, oblong, the midrib vanishing below the apex: filaments slightly pubescent near the base: ovary and styles glabrous: achene 3-angled.

Collected on Mt. Harvard, Colorado, 1896, by *Frederic E. Clements, no. 66.*

Related to *Eriogonum pauciflorum*, but stouter and larger in all of its parts. The peduncles are mostly shorter than the leaves, which generally have flat instead of strongly revolute blades. The involucre of this species is narrower and much longer than that of *E. pauciflorum* and has the tube proportionally longer and the lobes proportionally shorter. The calyx too is at least one millimeter longer than that of *E. pauciflorum.*

Eriogonum nudicaule (Torr.)

Eriogonum effusum nudicaule Torr. Pacif. R. R. Rep. **4**: 132. 1857.

Related to *Eriogonum lonchophyllum* T. & G., differing in the larger calyx, the campanulate involucre and the revolute leaf-blades.

Eriogonum scoparium sp. nov.

Perennial, with woody rootstocks and more or less elongated caudices (section *Corymbosa*). Leaves rather few on each caudex, but sometimes apparently numerous on prolifically branched plants; blades linear to linear-spatulate, 2–5 cm. long, revolute, at least in age, densely lanate beneath, floccose above, relatively short-petioled, the sheathing bases of the petioles very densely woolly: scapes mainly 1–2 dm. tall, glabrous, glaucescent, each topped with a compound open cyme, the bracts very small, the lower ones often subulate-tipped: involucres broadly campanulate, 2.5–3 mm. long, and about as wide at the mouth, the lobes broad, decidedly shorter than the tube: calyxes pink or whitish, becoming 3.5–4 mm. long, the lobes oblong to obovate: filaments pubescent at the base: ovary and styles glabrous: achenes 2.5 mm. long.

The type was collected at Gunnison, Colorado, September 12, 1901, by *Underwood & Selby, no. 376;* other collections from Colorado are as follows: Gunnison, July 7, 1901, *Baker 254.* Denver, September, 1892, *Eastwood.*

This species may be distinguished from *Eriogonum nudicaule*

and *E. lonchophyllum* by the long-peduncled involucres in the forks of the inflorescence and from *Eriogonum salicinum* and the following species by its campanulate involucres.

Eriogonum tristichum sp. nov.

Perennial with woody rootstocks and somewhat elongated caudices (section *Corymbosa*). Leaves rather few on each caudex; blades narrowly linear, oblanceolate or linear, 2–7 cm. long, usually revolute, floccose above, densely white-woolly beneath; sheathing bases of the petioles very densely white-woolly: scapes mainly 1–3 dm. tall, glabrous, except at the base, glaucescent, each topped with a compound cyme, the bracts very small except sometimes those at the first fork of the inflorescence: involucre turbinate, 2.5–3 mm. long, decidedly longer than thick, the lobes broadly rounded, much shorter than the tube: calyxes pink or whitish, becoming 4 mm. long, the lobes obovate to oblong-obovate: filaments sparingly pubescent at the base: ovary and styles glabrous: achenes about 2.5 mm. long.

The type was collected at Rosa, Colorado, June, 1899, by *C. F. Baker, no. 286;* other specimens have been collected in Colorado as follows: Black Cañon, Gunnison, September 1888, *Parry.* Mesa Verde, September, 1892, *Eastwood.* Arboles, June, 1899, *Baker, 287.* Parlin, August, 1891, *Smith, 53. Eriogonum tristichum* differs from its nearest relative, *E. salicinum*, in its larger and relatively longer involucre and the strongly revolute leaf-blades.

Eriogonum Fendlerianum (Benth.)

Eriogonum microthecum Fendlerianum Benth. in DC. Prodr. **14**: 18. 1856.

This species is related to both *Eriogonum corymbosum* and the following species but may be easily distinguished from either by its larger involucre.

Eriogonum divergens nom. nov.

Eriogonum corymbosum divaricatum T. & G. Pacif. R. R. Rep. **2**: 129. 1855. Not *E. divaricatum* Hook.

Like the preceding, this species is related to *Eriogonum corymbosum*, from which it may be distinguished by the larger more prominently lobed and scattered involucres, and the stiffly spreading branches of the inflorescence.

Eriogonum fusiforme sp. nov.

Annual (section *Pedunculata*), glaucous. Leaves spreading; blades suborbicular, 1–5 cm. in diameter, rounded or bluntly apiculate at the apex, with scattered hairs on both surfaces, or hirsute beneath, hirsute-ciliate; petioles longer than the blades, or shorter, hirsute: scapes solitary or tufted, 2–5 dm. tall, markedly inflated below the several or many inflorescence-branches: peduncles capillary, spreading, many times longer than the involucres, abruptly bent at the base: involucres turbinate, barely 1 mm. long, the lobes ovate, shorter than the tube: calyxes white or mainly so; lobes ovate, becoming 1.5 mm. long, closely pubescent: filaments glabrous: ovary and styles glabrous: achenes about 2 mm. long, the tips exserted.

Type collected at Grand Junction, Colorado, June 20, 1893, by *De Alton Saunders;* the species is also represented by the following specimens:

COLORADO: Palisade, May 29, 1894, *Crandall.* UTAH: St. George, 1877, *Palmer 434.* Bluffs near Green River, June 15, 1901, *Stokes.* ARIZONA: Peach Springs, June 28, 1887, *Tracy & Evans 315.*

This species differs from *Eriogonum inflatum*, its nearest relative, in the much smaller turbinate and few-flowered involucres and the usually numerous large and divaricate accessory inflorescence-branches.

Polygonum buxiforme nom. nov.

Polygonum littorale Small, Mem. Dept. Bot. Columbia Coll. **1**: 102. (excl. synon.) 1895. Not *P. littorale* Link.

Polygonum rubescens sp. nov.

Perennial or sometimes annual, glabrous, bright-green. Stems ultimately branched at the base and above it, the branches ascending or spreading, 1–5 dm. long, striate: leaves scattered; blades thickish, narrowly oblong to elliptic or nearly linear, mainly 1–2.5 cm. long; ocreae silvery, or brown at the base, at length lacerate: flowers usually several in a cluster: calyxes becoming 3 mm. long; lobes with whitish or pinkish margins: achenes triquetrous, 2–2.5 mm. long, dull and distinctly granulate or striate.

Type collected in sandy soil at Parlin, Gunnison County, Colorado, August 16, 1901, by *B. H. Smith, no. 55;* other specimens belonging here are as follows:

COLORADO: Larimer County, June 17, 1895, *Cowen.* IDAHO:

Kootenai County, August 26, 1892, *Sandberg, MacDougal & Heller 966.* NEVADA: Unionville, September 1867, *Watson 1055.*

A species related to *Polygonum ramosissimum*, from which however it differs in the smaller whitish or pinkish margined calyx-lobes and the smaller and rougher achene.

Persicaria omissa (Greene)

Polygonum omissum Greene, Pittonia **5**: 200. 1903.

This species is known from both Kansas and Colorado.

Bistorta bistortoides (Pursh)

Polygonum bistortoides Pursh, Fl. Am. Sept. 271. 1814.

Polygonum Bistorta oblongifolium Meisn in DC. Prodr. **14**: 126. 1856.

This species of *Bistorta* is common in the mountains of Colorado and also in the neighboring states.

NEW YORK BOTANICAL GARDEN.

INDEX TO AMERICAN BOTANICAL LITERATURE

(1905)

The aim of this Index is to include all current botanical literature written by Americans, published in America, or based upon American material; the word America being used in its broadest sense.

Reviews, and papers which relate exclusively to forestry, agriculture, horticulture, manufactured products of vegetable origin, or laboratory methods are not included, and no attempt is made to index the literature of bacteriology. An occasional exception is made in favor of some paper appearing in an American periodical which is devoted wholly to botany. Reprints are not mentioned unless they differ from the original in some important particular. If users of the Index will call the attention of the editor to errors or omissions their kindness will be appreciated.

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